BBC
Sky at Night
MAGAZINE

THE ASTRONOMER'S YEARBOOK 2025

Your guide to the stars for the next 12 months

The year's big eclipses, comets & meteor showers

When and where to find the planets each season

10 easy targets for your first astrophoto

Up close with beautiful Saturn, the Ringed Planet

Top tips for family friendly stargazing

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Welcome

This complete stargazing guide provides all the information you need to enjoy the best sights in the night sky throughout 2025.

The Sky Guide offers useful advice, month by month, to help you navigate through the cosmos. Find out the best times to catch meteor showers, planetary oppositions, occultations, rare conjunctions, clair-obscur effects and noctilucent clouds. Discover the delights of constellations such as Canes Venatici, Serpens, Cetus and Cepheus.

Longer articles let you dive a bit deeper: discover 10 top targets in the night sky, find out how to build your own eyepiece collection, have a go at the Caldwell challenge, and discover ways to enjoy astronomy with the whole family – young and old.

If you're up for a challenge in 2025, have a go at spotting lunar valleys, or observing gas giant Jupiter and ringed planet Saturn in the Challenge Yourself section. You'll also find loads of practical advice, such as the best equipment available, or how to star hop the night sky, master averted vision or predict an aurora display. And don't miss the gallery of winning images from *Sky at Night Magazine*'s monthly astrophoto competition.

All this and more! Indeed, with the *Astronomer's Yearbook* to hand, you can make the most of your nights under the stars in 2025. Enjoy, and clear skies!

Chris Bramley, Editor

Contents

Month-by-month sky guide

38 January
42 February
48 March
52 April
56 May
62 June
66 July
70 August
76 September
80 October
84 November
90 December

Seasonal constellations

46 Spring constellation: Canes Venatici
60 Summer constellation: Serpens
74 Autumn constellation: Cetus
88 Winter constellation: Cepheus

Challenge yourself

100 Project 1: Observe gas giant Jupiter
102 Project 2: Spot lunar valleys
104 Project 3: Capture the ringed planet

Features

6 Family-friendly astronomy
12 10 astrophotography targets
18 Build your eyepiece collection
24 Take the Caldwell challenge
94 Gallery: astrophotography winners

Equipment round-up

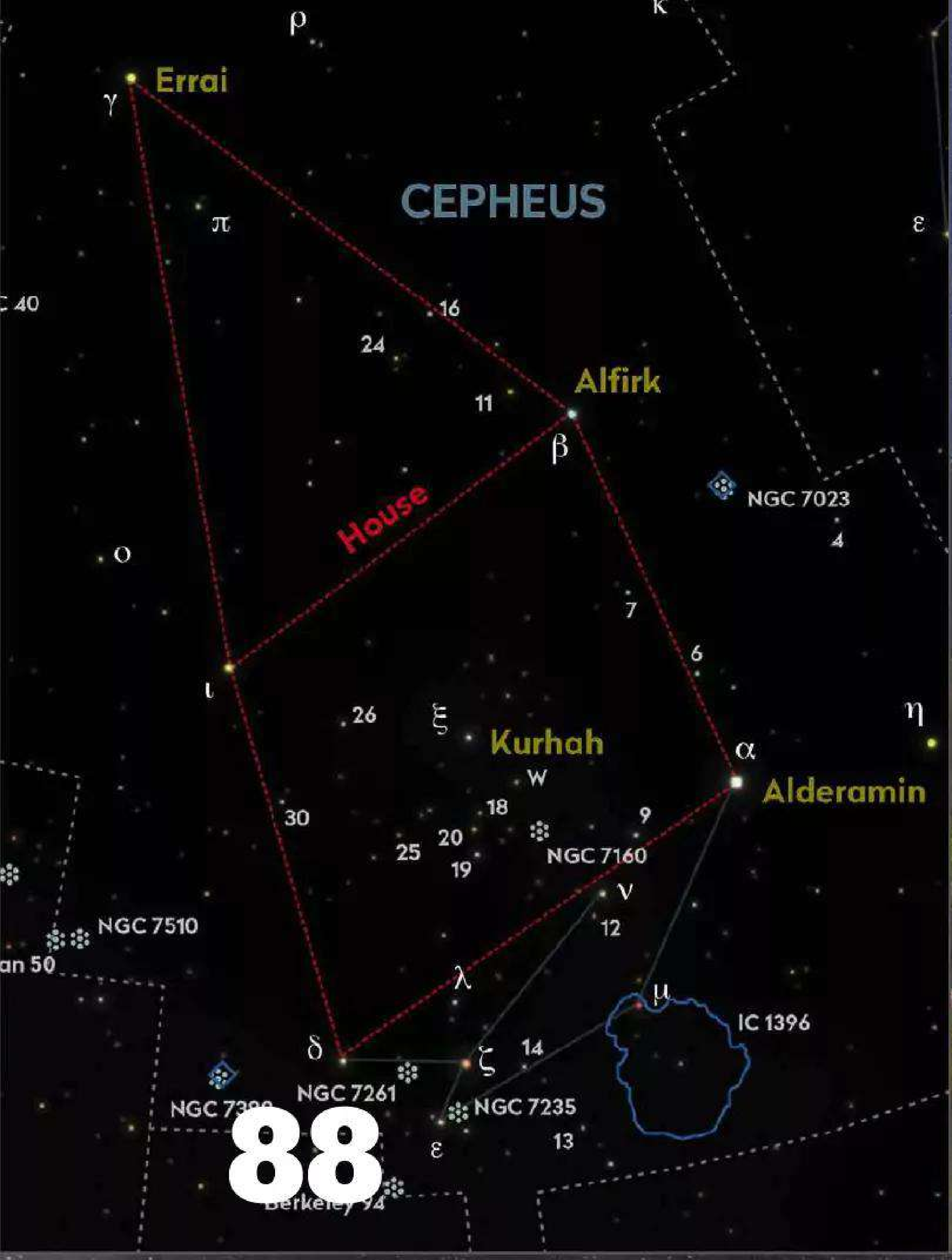
31 ZWO Seester S50 smart scope
32 Celestron SkyMaster Pro ED 15x70 binoculars
33 Askar V apo modular telescope kit
34 Masuyama 1.25-inch 53° eyepieces
35 Altair Astro Hypercam 585C colour camera

Skills for stargazers

106 Star-hopping
108 Master the art of averted vision
110 Predict an aurora display

Plus...

112 Subscribe to *BBC Sky at Night Magazine*
114 A closing thought...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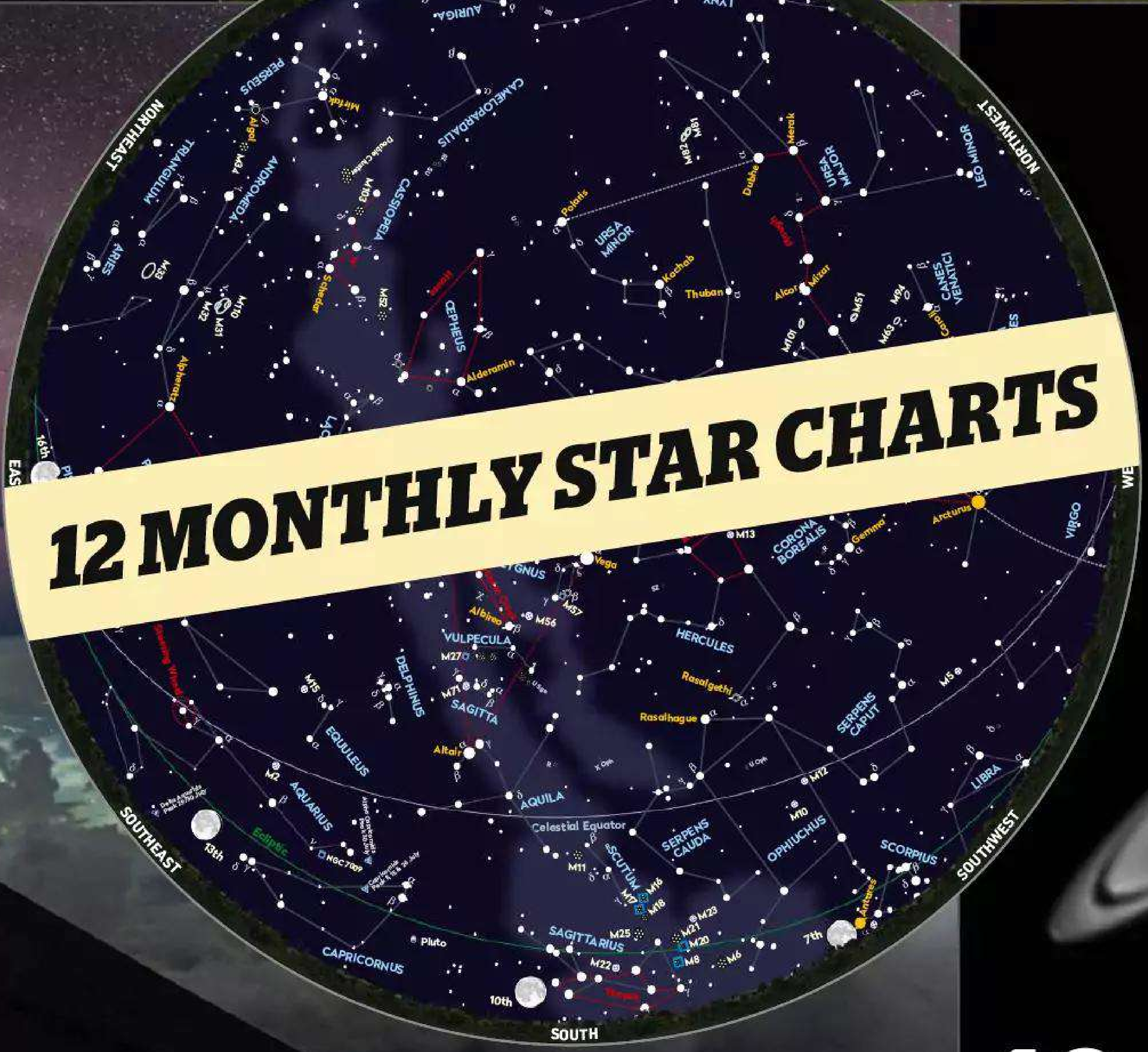
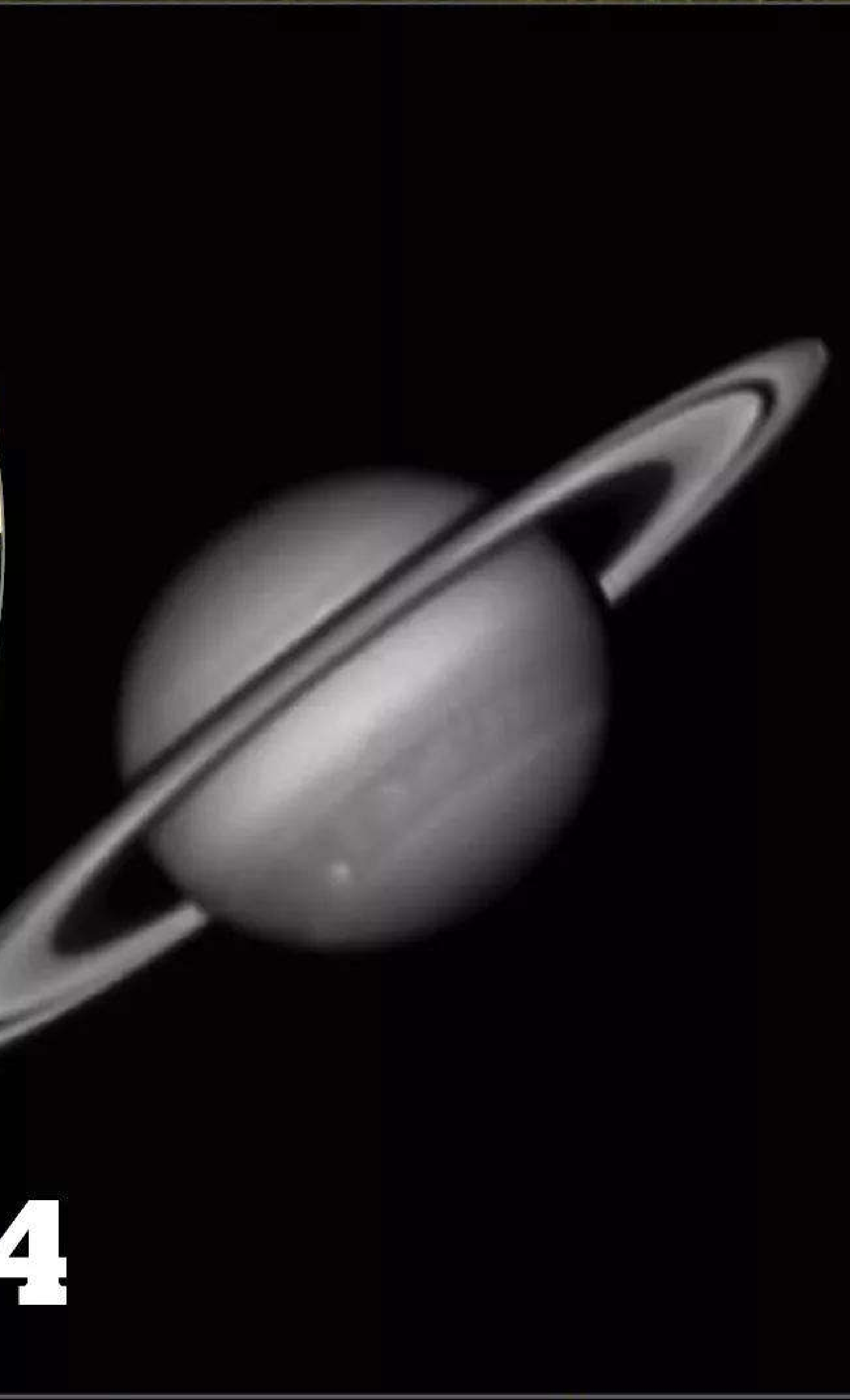


12 MONTHLY STAR CHARTS

NORTH
NORTHEAST
NORTHWEST
SOUTHEAST
SOUTHWEST
SOUTH
EAST
WEST



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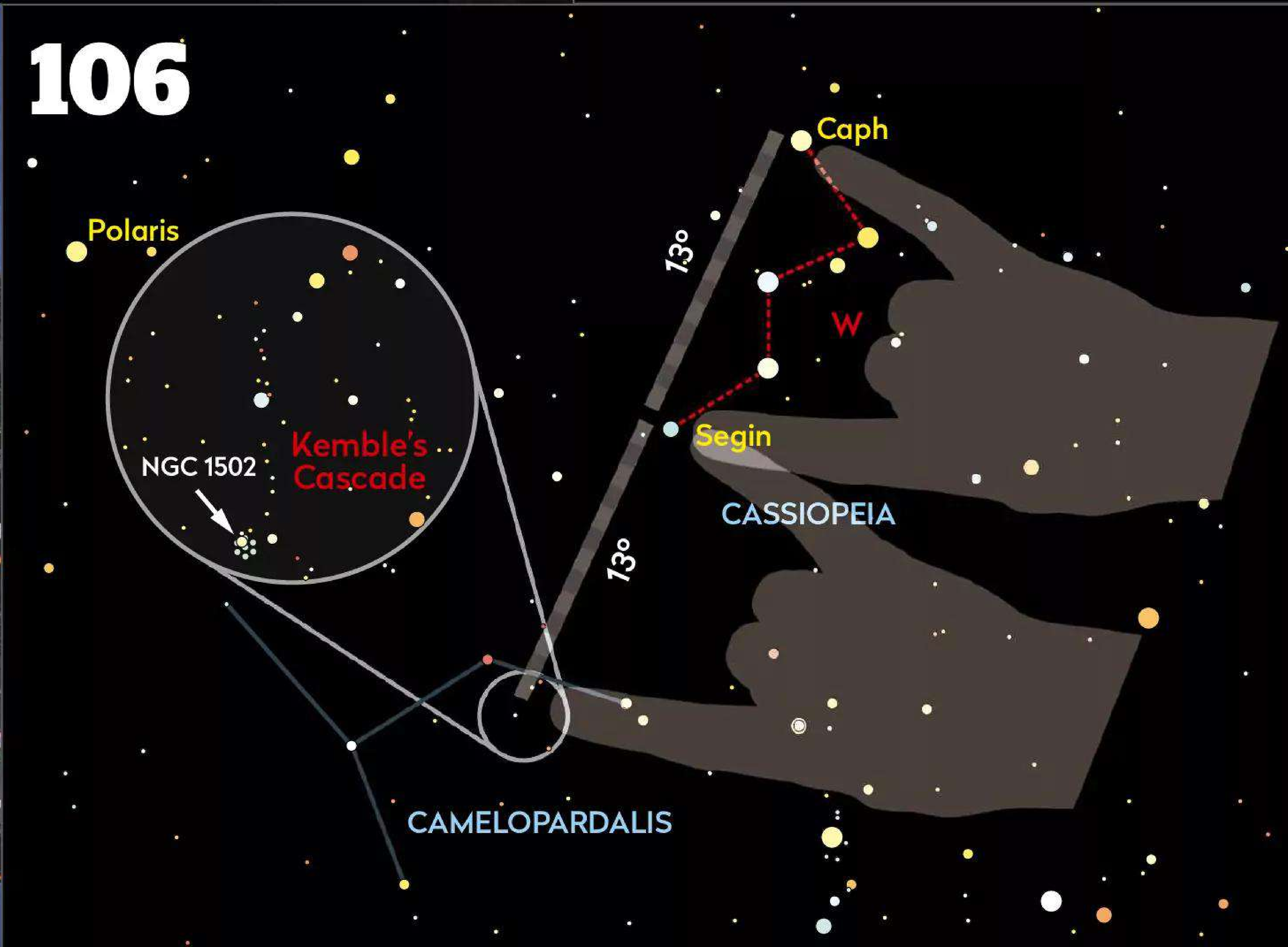

Caph
Polaris
13°
W
Segin
Kemble's Cascade
NGC 1502
CASSIOPEIA
13°
CAMELOPARDALIS

106

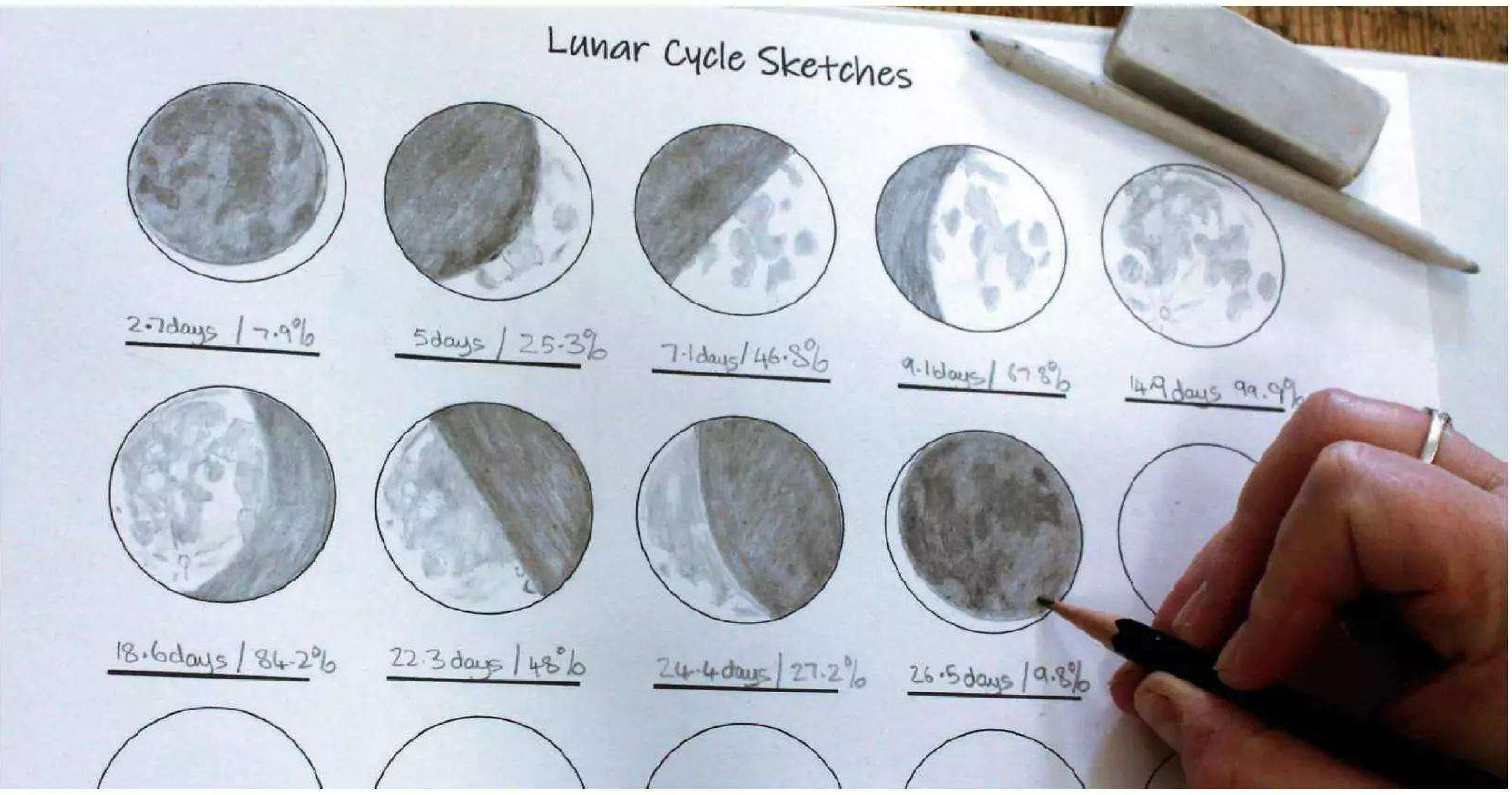
All together now: get the family off their devices and out sharing the wonders of the night sky

Family-friendly ASTRONOMY

Mary McIntyre reveals practical tips and fun projects that will get the whole family – young and old – looking up

Finding an activity that everyone in the family is happy to take part in can be challenging. If you've ever tried to arrange a family movie night, you'll be familiar with the struggle! One activity that you can easily do as a family is practical astronomy. You may have children of different ages, with teenagers hesitant to join in. You may have family members with mobility problems or those who think they're not interested in astronomy. Practical astronomy is fun and can be adapted to suit all needs and interests.

We're going to look at some stargazing activities that can be done all year round, but the winter months are ideal as it gets dark early, so young children won't need to stay up late. You don't need expensive equipment: just dress warmly, get yourself a red-light torch, a star chart or planisphere and find a place in your garden or local park where you're shielded from streetlights. There are also great night-sky apps to try; remember to turn your phone screen red and the brightness down, to help your night vision. Perhaps the best advice of all, though, is to take things at your own pace and have fun!



▲ A pencil and paper are all you need to get to know the phases of our Moon. Draw what you see as it waxes and wanes

1. Observe the Moon

▲ Get a real feel for the lunar surface with a 3D-printed model

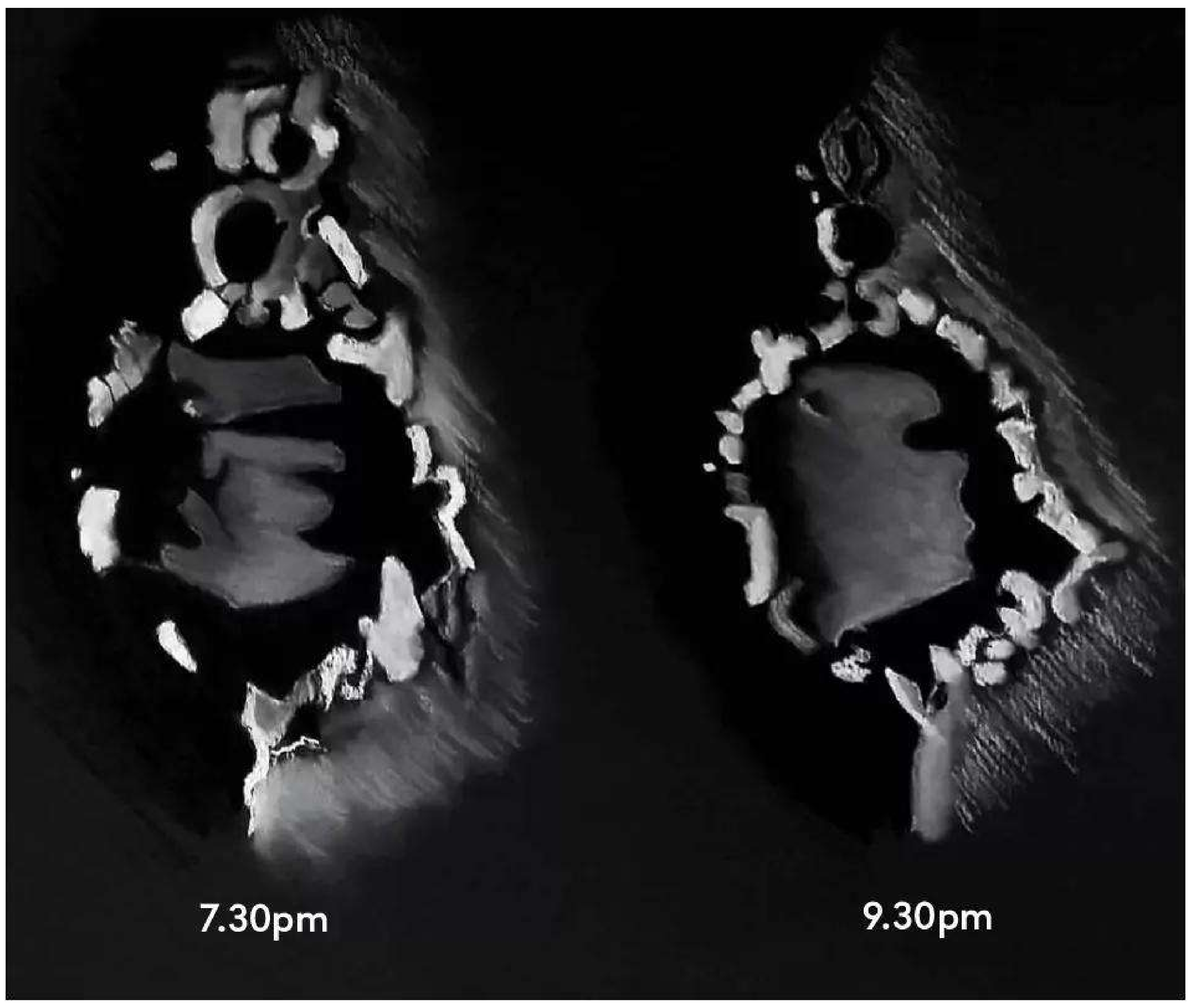
The Moon is a fantastic target for astronomers of all levels, and a great place to get started is by creating pencil sketches of it during an entire lunar cycle. How does it change day by day? What effect does the changing illumination have on the features?

Choose a time when the Moon is about half-illuminated – that's when its southern hemisphere craters are most distinct. Start by observing the Moon with the naked eye and make a note of the features you can see. Then look at it through binoculars: what can you see now that you couldn't see before? Finally, observe it with a telescope and different eyepieces. What does the telescope show you that binoculars didn't? You can research these features and how they formed.

People with visual impairment – and everyone else – can enjoy learning about the lunar landscape by using clay models made by a family member, or 3D-printed models. You can also use a torch on the model to try to mimic the shadow effects that you'll observe in the next activity.

Using a telescope and a high-power eyepiece, locate a lunar crater that has nice shadows around it; ones that fit the bill will be near to the boundary between the illuminated and unilluminated sides of the Moon (the 'terminator'). Note the time and make a sketch showing the shape and length of the shadows. Two hours later, observe the same crater and make another drawing. How have the shadows changed over the two-hour period?

If you have a maths whizz in the family, they could try measuring the width of the crater and the length of the shadows, then using those numbers to calculate the height of the crater wall. Find out how to do this online at **bit.ly/crater-height.** ▶

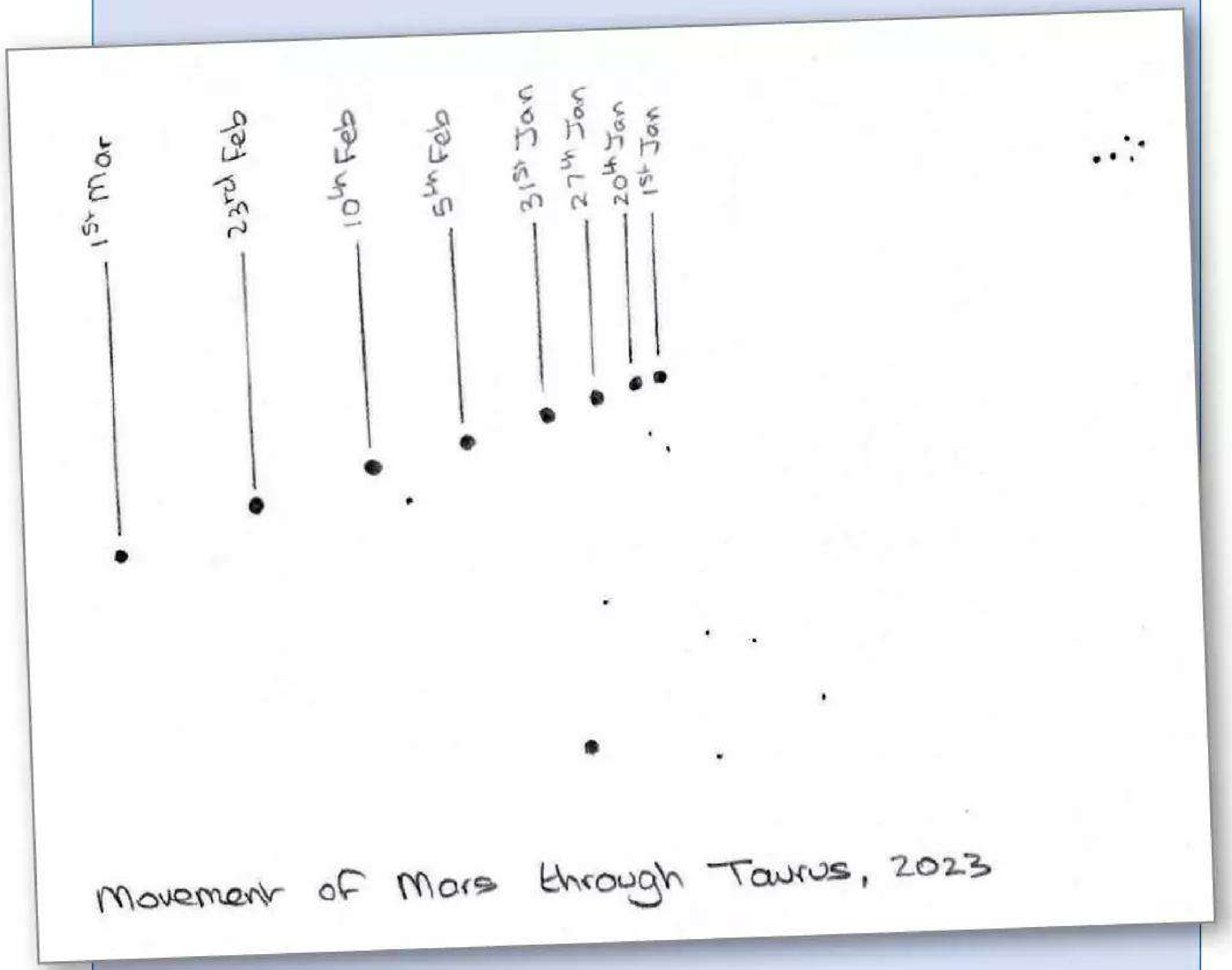


▲ Sketches will reveal how the Moon's crater shadows change

ANDRII BILETSKYI/ALAMY STOCK PHOTO, MARY MCINTYRE X 3

2. Track a bright planet through a constellation

The movement of planets is different from that of the stars, which is why they were historically called 'wandering stars'. It's great fun to track the movement of a planet against the background stars, and you can do this with the naked eye or with binoculars. Try it during January and February when Mars is very well-placed in Taurus, having had its closest approach to Earth in December. Make a sketch of the stars in Taurus, then mark the location of Mars several times over a couple of months. Take note of how far it has moved between each observation and what direction it is moving in.



▲ Sketch the stars in the constellation of Taurus and watch how Mars moves through the scene in the coming weeks

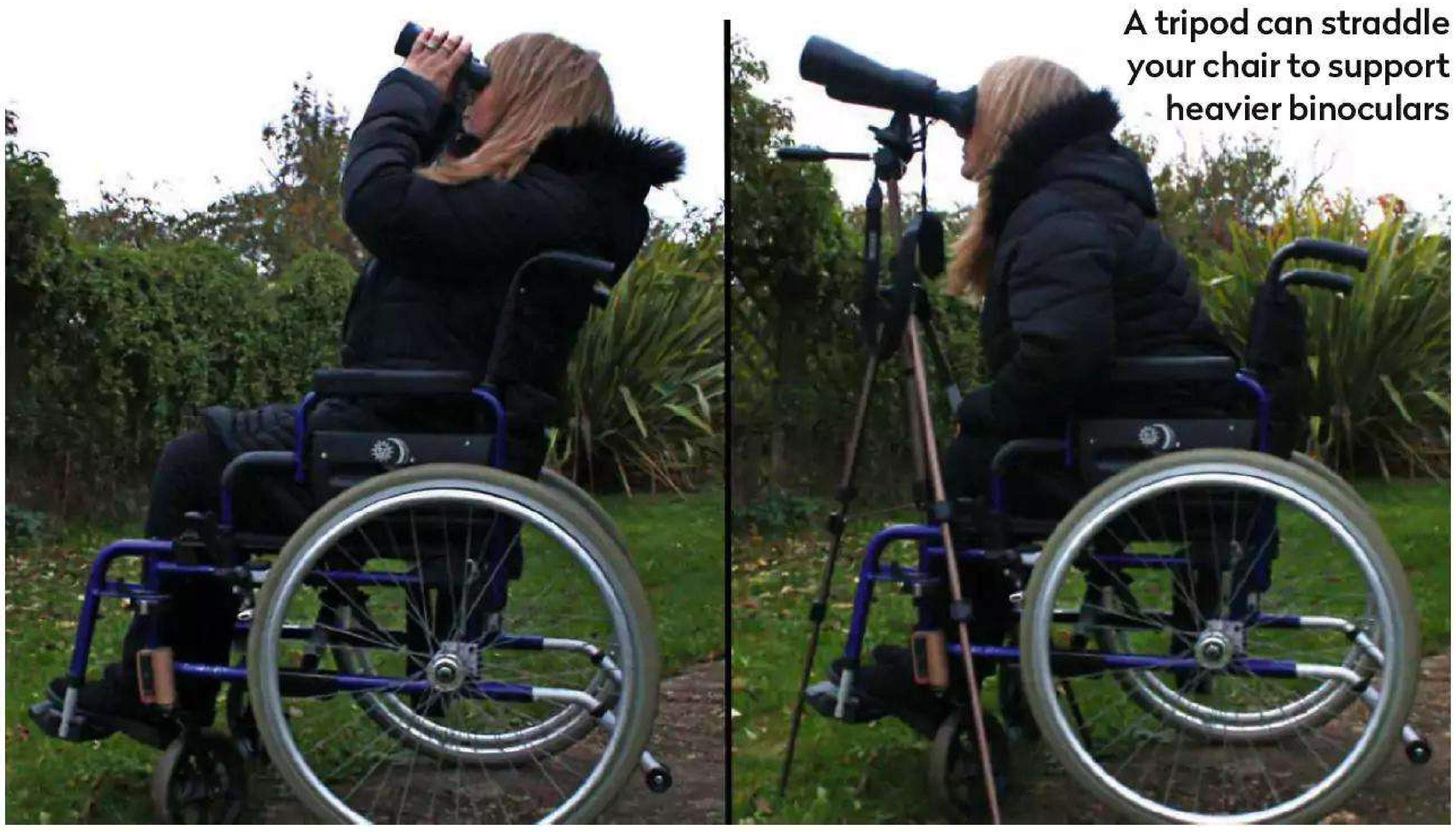
A favourite star and a bit of maths will prove Earth's spin takes less than 24 hours

3. How long does it take for Earth to make one rotation?

Earth takes 24 hours to complete one rotation, right? It actually takes slightly less than that. You can test out how much less by studying the movement of the stars. Position yourself so you can see a bright star disappear behind a chimney pot. Note the exact time it vanishes. Repeat this with the same star, from the same position, over the next few nights, noting how many minutes difference there is. After a week, you'll have six values. Add them, divide the total by six to get the average, and convert them to seconds. Watching Vega we saw a difference of four minutes and five seconds (245 seconds). The published figure is three minutes 56 seconds (236 seconds) short of 24 hours: that's one rotation every 23 hours, 56 minutes and four seconds. What do you get?

4. Mobility problems? Binocular solutions

Visual astronomy with a telescope can be challenging for people with mobility issues, but binoculars are a brilliant alternative. Small binoculars have the advantage of being lightweight so they can be hand-held. If you have larger, heavier binoculars, mounting them can make all the difference. A simple tripod mount works well when viewing objects that are lower in the sky, and you can straddle the tripod legs around a stool or wheelchair. If you're viewing objects that are higher, a parallelogram mount is a better option because they allow much easier access to the eyepiece from a seated or standing position.



A tripod can straddle your chair to support heavier binoculars

MARY MCINTYRE X 2, STEVE MARSH X 2, SAVOILIC/ISTOCK, GETTY IMAGES

5. Get the whole family using a telescope

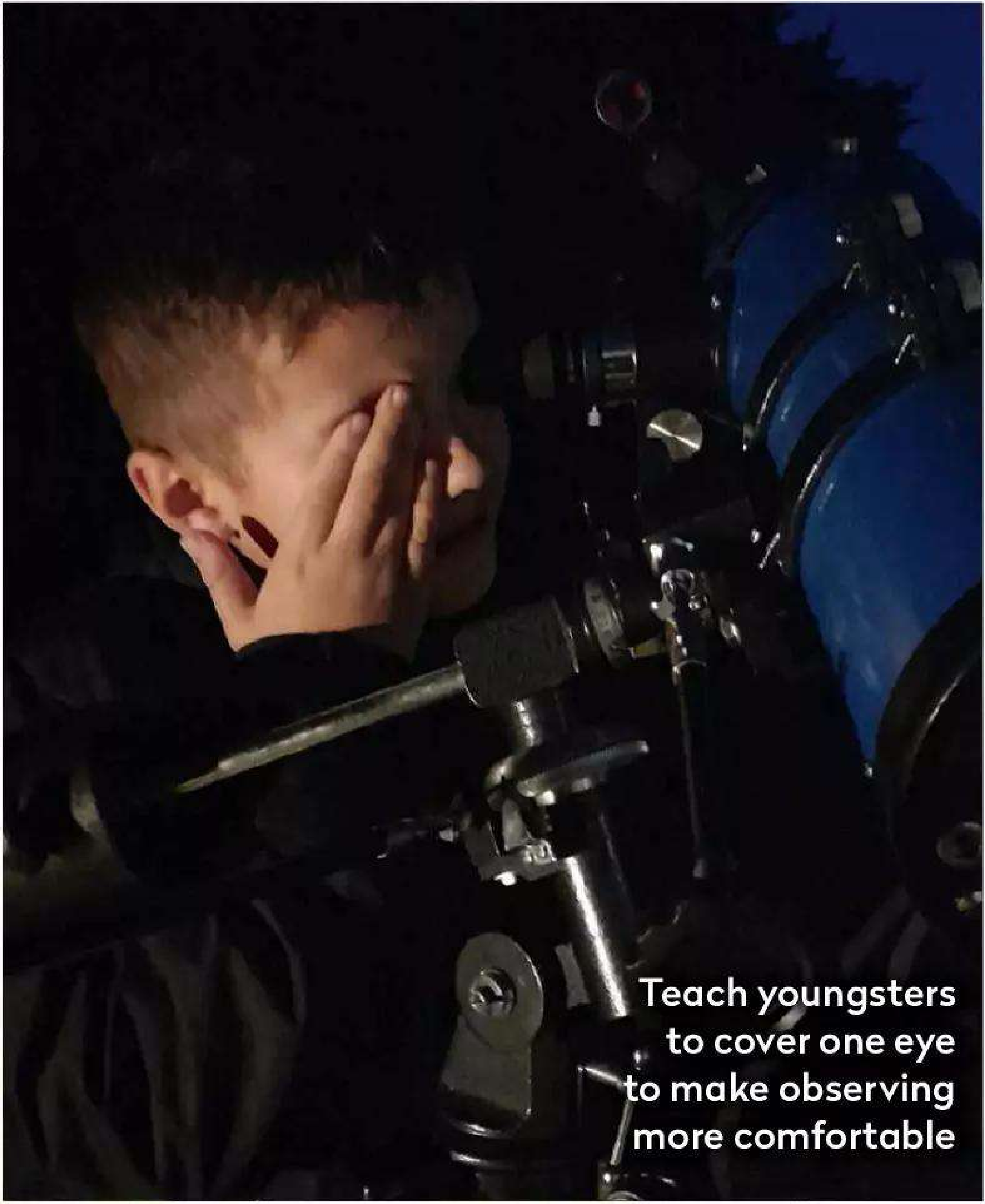
Do you have a telescope? Has the whole family had a go yet? A few practical tips will help you to get the most out of your first family observing session.

Ergonomics are important. If you're not comfortable when looking through an eyepiece, your body will quickly feel fatigued. Set the tripod to the correct height for the observer. If you have a refractor, rotate the barrel so the eyepiece is in the right position for family members of different heights. Consider a perching stool for comfort and back support. For a reflector, have younger children stand on stepstools to look through the eyepiece; they won't be able to observe properly if they're being carried.

Scrunching one eye closed while observing with the other is not comfortable and your facial muscles will quickly become tired. A better technique, especially for children who sometimes struggle to close only one eye at a time, is to keep both eyes open but cover one with your hand. You can also buy astronomers' eye patches for this purpose and enjoy looking like a pirate astronomer!

Beginners may feel underwhelmed the first time they observe an object visually compared to the amazing long-exposure photographs we see, so it is important to manage expectations. Knowledge about the distance the light has travelled from the object to their eye, as well as other basic facts about the object can help everyone to feel that important visual connection. The longer you look at something through an eyepiece the more faint detail you will see, so encourage people to spend a long time observing each object. This is also an opportunity to use averted vision, a technique of looking off to one side of a faint object so that it will appear to brighten in your peripheral vision. ▶

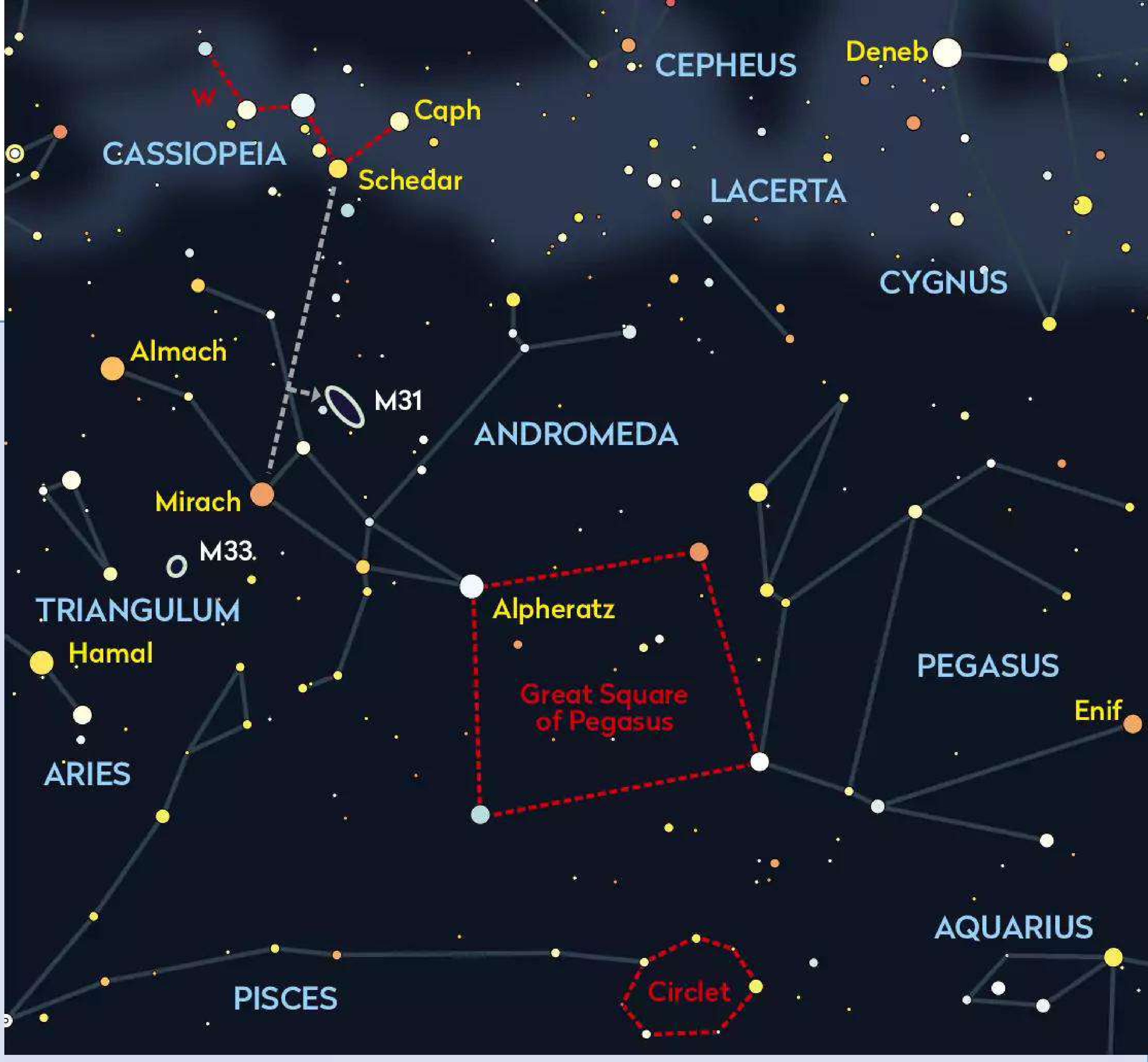
Provide a stool so younger children can reach the eyepiece easily



Teach youngsters to cover one eye to make observing more comfortable

6. See the far-distant Andromeda Galaxy with your naked eye

At 2.5 million lightyears away, the Andromeda Galaxy, M31 is the most distant naked-eye object. You'll need a relatively dark, moonless night and dark-adapted eyes to see it: around 7pm during mid-January is a great time to try. Locate the star Mirach in the constellation of Andromeda and then Schedar, the bottom star on the right-hand side of the 'W' of Cassiopeia. Draw an imaginary line between the two. The Andromeda Galaxy lies about a third of the way along from Mirach and slightly below the line. You may need averted vision to see the faint smudge. How does it appear through binoculars or a telescope?



▲ **Trace a line from Andromeda's 'hip' star, Mirach, up to Schedar to locate M31, the most distant thing you can see with your naked eye**

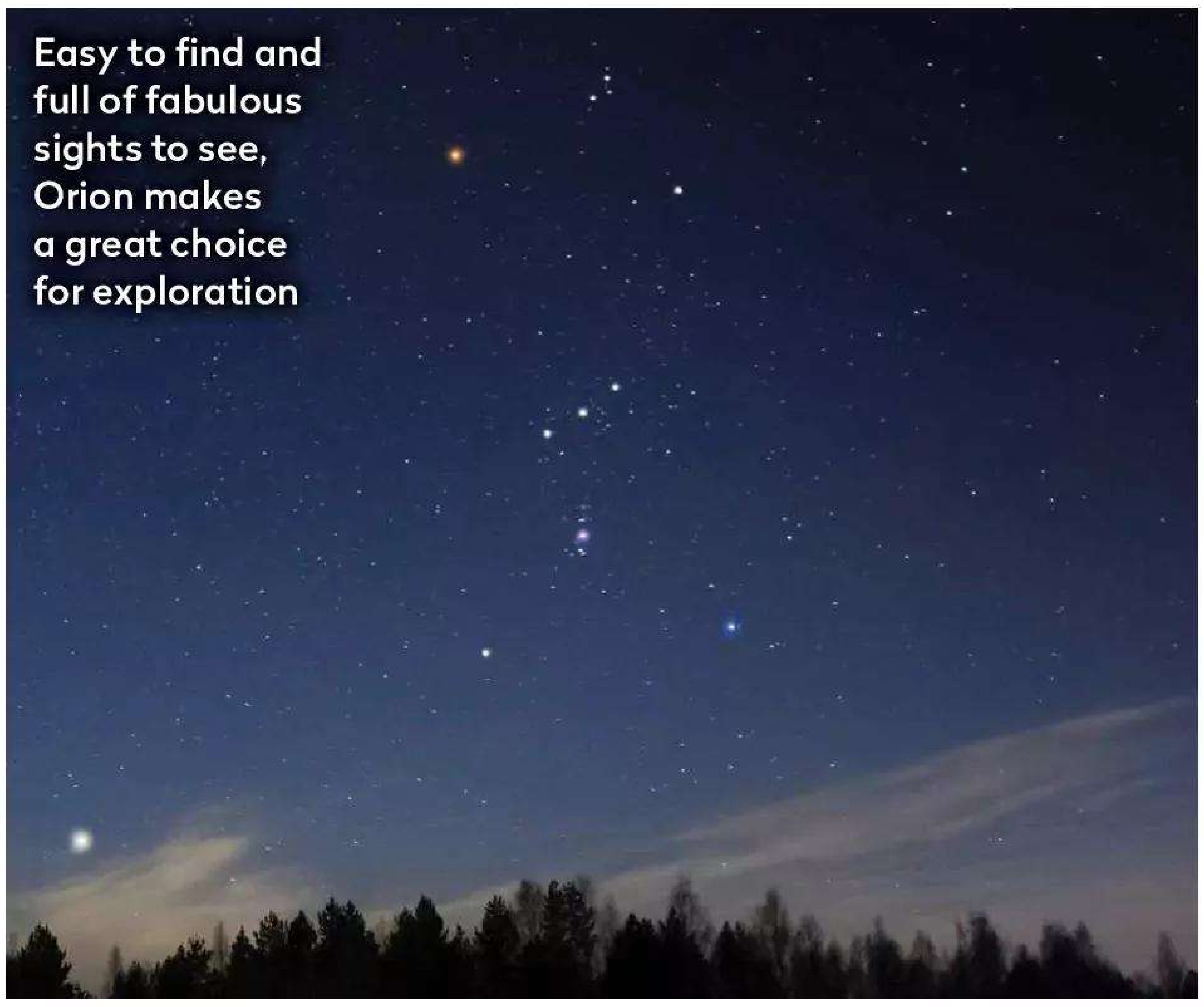
7. Take a deep dive into a constellation

This activity is great because you can keep it simple or get quite complex. Choose any constellation: Orion is a great choice during the winter because it is full of interesting sights and easy to spot.

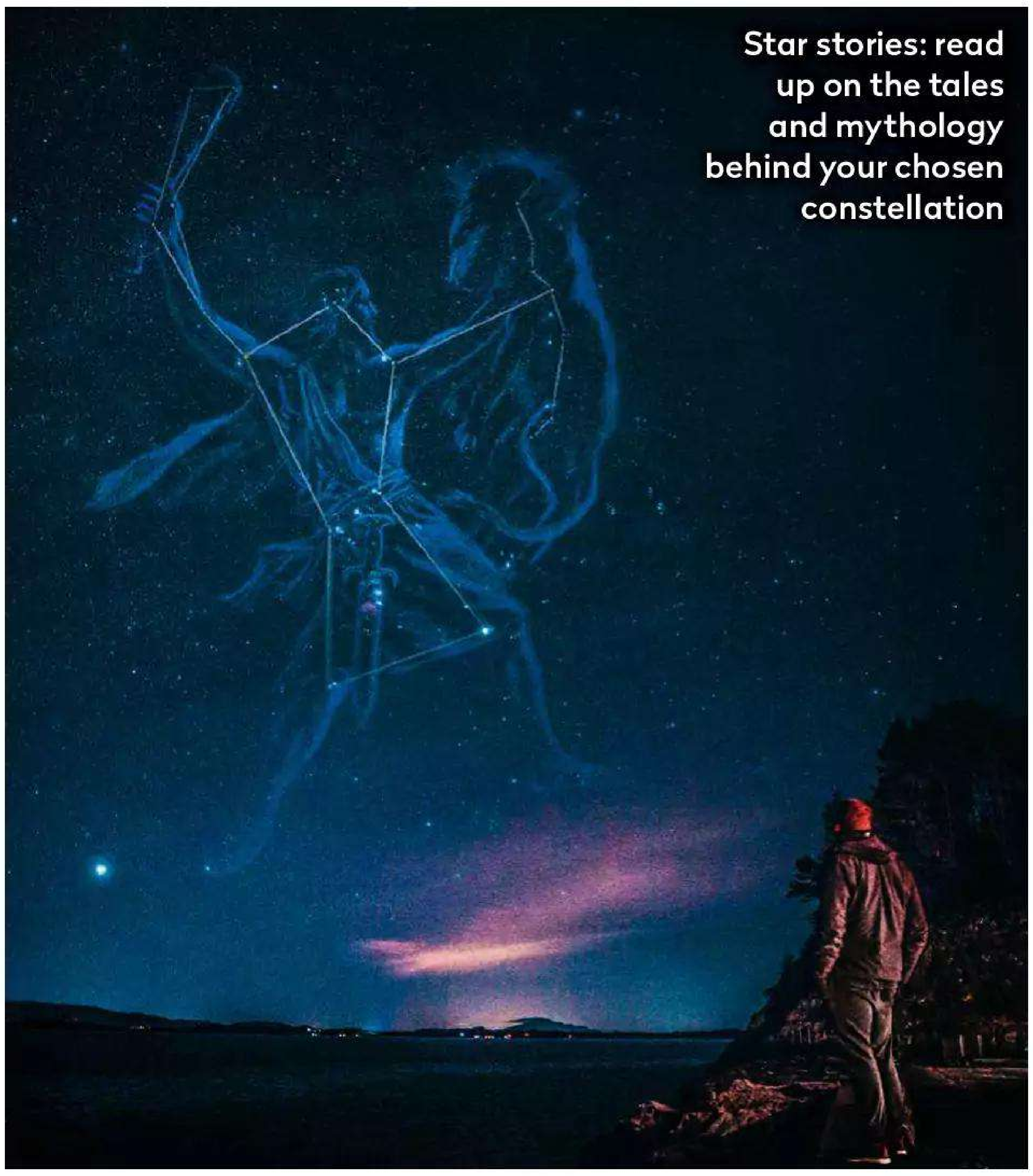
Research your constellation's Greek mythology. Do the star patterns look like the character or object? How does it compare to mythologies from other cultures? What do *you* think it looks like? Draw your own character and write a story about them.

On a moonless night, count how many stars you can see in the constellation when you first go out, before your eyes have adapted to the darkness. Repeat after 15 and 30 minutes outside. How many more stars can you see? Are they different colours? Try again under a bright Moon. Does this affect your count? You can even then try with the constellations that lie adjacent to it.

Sketch your constellation, paying attention to the stars' spacing and magnitude (brightness) differences. Drawing makes you a better observer, so encourage everybody to try! Take a photo of your constellation using a smartphone camera and app such as NightCap, or with a DSLR camera. Are there more stars in the photo compared to what you see?



Easy to find and full of fabulous sights to see, Orion makes a great choice for exploration



Star stories: read up on the tales and mythology behind your chosen constellation

Use a star chart and choose some deep-sky objects in your constellation and see if you can find them using binoculars or a telescope, learning how to get to them by star-hopping.

If you want to get complex, use theory to work out a star's absolute magnitude. First find the apparent magnitudes of nearby stars (how bright they look from Earth) and use them to estimate the apparent magnitude (m) of the stars in your constellation. The absolute magnitude (M) is how bright the stars would look if they were all 10 parsecs away. Look up the distances (d) to the stars in your constellation (in parsecs) and combine these with the apparent magnitudes to calculate the absolute magnitude from those figures, using the following formula: $M = m + 5 - 5 \log d$

CHART BY PETE LAWRENCE, EERIK/ISTOCK/GETTY IMAGES, LARS EMIL AGA HAUGOM/ ALAMY STOCK PHOTO, PAUL WHITFIELD, SKYSAFARI, ISS DETECTOR, PHILIPS

8. Connect a camera to your telescope

People with mobility problems or some visual impairment may physically struggle to look through a telescope eyepiece. A solution is to attach a camera to your telescope and display the view on a laptop. If using a smartphone camera, try apps such as DroidCam (Android and iOS) or EpocCam (iOS). DSLR users can use Backyard EOS, Backyard Nikon or DeepSkyStacker Live, while CCD or CMOS users can use SharpCap or FireCapture. Now everybody can share the view at the same time. Some software even offers a live stacking option that will slowly build up a more detailed view of the object, live on screen.

Display and share your telescope view on a laptop for everyone to enjoy

9. Use remote access

Family members who are housebound may feel they miss out on visual astronomy, but remote access technology can bring a telescope view inside. Connect your camera and telescope as described above and, as long as the laptop displaying the telescope view is connected to your home network, you can use RealVNC (downloads available for PC or Mac) or Windows Remote Desktop software to connect an indoor computer to the screen outside. This means those inside can still enjoy visual astronomy with the rest of the family. If the telescope is controlled by planetarium software, the person indoors can have complete control from inside the house.

10. Keep up to date with the night sky

There are always interesting things to spot in the night sky. *BBC Sky at Night Magazine* has a full roundup of what's coming up each month, and there are many books that show you events to look out for throughout the year. Great options are the Philip's *Stargazing* and *Collins Night Sky* guide books. Try your local library or secondhand book shop. There are also countless websites, newsletters and smartphone apps, such as Stellarium and SkySafari, which will inform you of the best constellations, meteor showers, planets and deep-sky objects to observe from your location. Lunescope is a fantastic lunar observing app. If you enjoy spotting the International Space Station and other satellites, use the Heavens Above website or the ISS Detector smartphone app. There is something that every family member will enjoy!

Mary McIntyre is an Oxfordshire-based astronomy speaker and educator

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NEW PLAN TO BUILD A TELESCOPE ON THE MOON
ON TEST: ALTAIR BUDGET SCOPE AND ZWO MOUNT

Current Location
Venus
Taurus
Orion
Betelgeuse
Rigel
ISS
International Space Station
RADAR
DETAILS
LIVE VIDEO
3d 7h 48m
Start time
Duration
End time
Start elev.
Max elev
End elev.
Start Direction
Magnitude
End Direction
Latitude
Longitude
Height
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BBC Sky at Night Magazine

◀ A host of astronomical resources are out there to help, from magazines and books to apps like SkySafari and ISS Detector

10 targets to get you started in astrophotography

From star trails to your first planets, **Tom Kerss** shares 10 inspiring projects to kick off your night photography journey

Tom Kerss is an astronomer and writer. His second children's picture book, *The Squirrel that Found the North Star*, is out now

There's a long-standing debate among amateur astronomers: which is better, observing the sky with your eyes or capturing it with your camera? It will always be a matter of personal taste, but the good news is that for anyone looking to try their hand at astrophotography, there's never been a better time. Whether it's taking casual snaps of the stars or delving into more advanced techniques – what the seasoned called 'imaging' – this hobby has seen an explosion of popularity. Increasingly ubiquitous astro-capable cameras and superb software have made astrophotography easier. Want to try it? Here are 10 targets to get you started. ▶

We bring you the tips, techniques and kit you'll need to take your first steps into night-sky photography

BOJANSTORY/ISTOCK/GETTY IMAGES

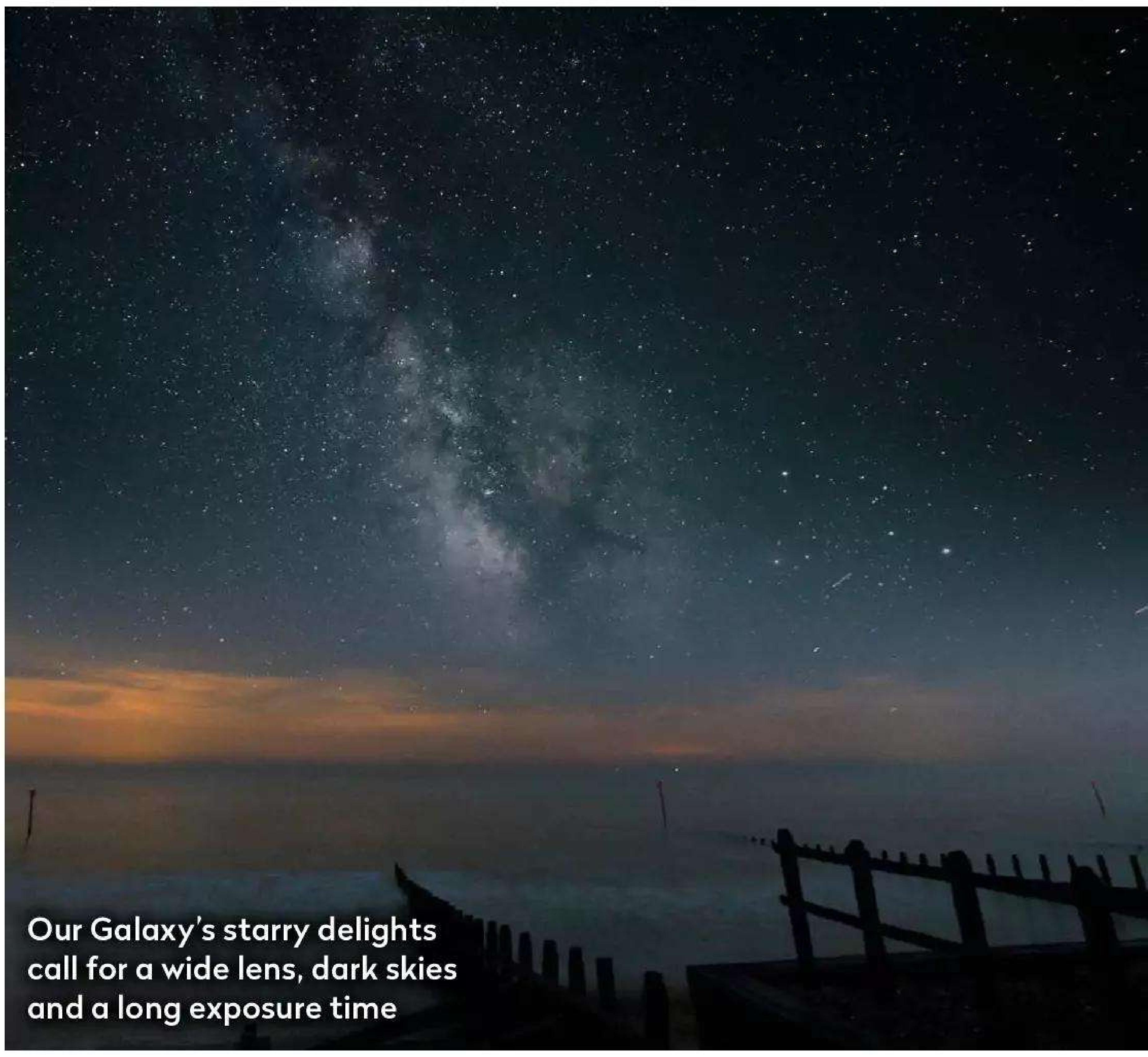
Start simple

Nothing is easier than placing your camera or smartphone on a tripod and shooting away, as you'll find with these entry-level projects

1. The Milky Way

Capture the river of light that crosses the sky

The warm nights of summer and the early autumn invite us to stay out and enjoy the splendour of the Milky Way. Rich with the light of billions of stars, it's a perfect playground for experimenting with your camera. Investigate your lenses and choose a wide one with a fast maximum aperture, such as f/1.4, f/2.8 or f/4. Angling your camera up to the sky, you should be able to see various brighter stars on its live view screen. This will aid with manually focusing and with framing the Milky Way's bright core. With an ISO value of 800 or 1600, take exposures of 5–15 seconds. Star trailing will become evident on longer exposures, but use the '500 rule' to avoid the shot being spoiled. This states that your maximum exposure (in seconds) should be no more than 500 divided by your lens focal length in millimetres. For example, with a 14mm lens don't go longer than 500 ÷ 14 = 36 seconds. If your camera has a crop factor (see your user manual), multiply the focal length by that first. So for a 14mm lens on a DSLR with a 1.6x crop factor, the maximum exposure time becomes 500 ÷ (14 x 1.6) = 22 seconds.



Our Galaxy's starry delights call for a wide lens, dark skies and a long exposure time

2. Meteors

Catching shooting stars is mostly down to serendipity, but you can give luck a helping hand

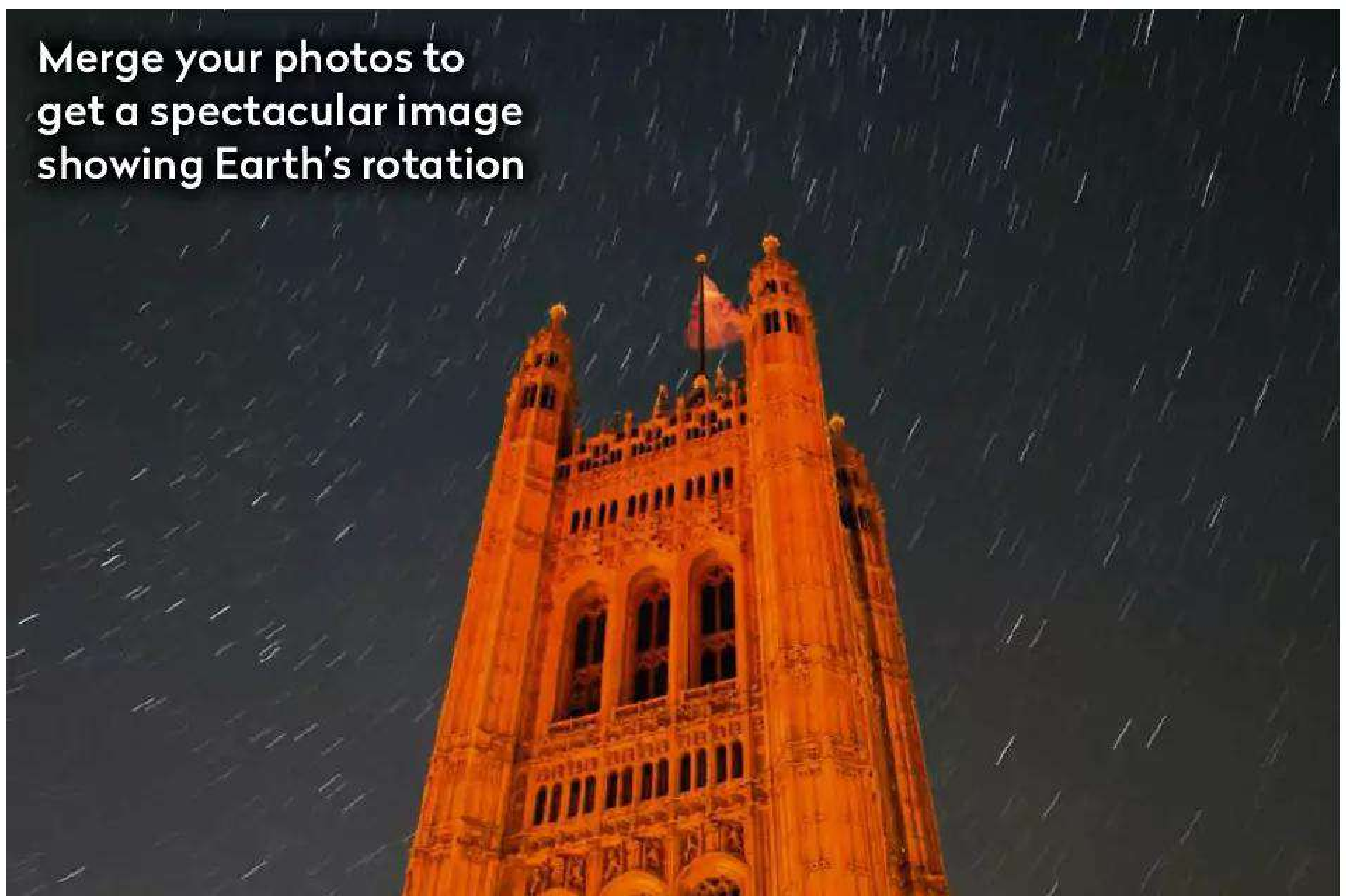
Taking lots of shots at regular intervals will help you nab a meteor

When shooting the night sky, it's not uncommon to capture a streak of light. Usually this is a satellite trail, but rarely you'll encounter a natural streak – a meteor! It's mainly down to chance, but you can greatly increase your odds by shooting during a meteor shower and by taking a continuous sequence of exposures. Using an intervalometer, or timelapse remote, you can set your camera going and enjoy the shower with your own eyes. Later, skim through your images and see what you get. Bright meteors, such as fireballs, will be hard to miss and often produce varicoloured trails as they travel through the atmosphere. Your camera may have onboard noise reduction enabled – switching this off will minimise the gaps between exposures. Of course, if like me you're often terribly unlucky, you might not catch any meteors, but your sequence of identical images can still be put to good use for creating star trails.

3. Star trails

The arcs of passing stars are a great way to show the motion of Earth on its axis

Whenever you try to shoot a meteor shower, you'll end up with perhaps hundreds of identically positioned photographs, evenly spaced in time. These are ideal collections from which to create star trail images. Such beautiful works of art illustrate the rotation of Earth and, as each star in the sky traces its arc around the celestial pole, the effect becomes more dramatic when facing north. Star trails also look fantastic in contrast with a perfectly still foreground, such as a building or rock feature. There are two excellent, easy-to-use pieces of free software that turn your sequences into trails: StarStaX by Markus Enzweiler, which is available for macOS and Windows (**markus-enzweiler.de/software/starstax**), and Sequator by Yi-Ruei Wu, which is available for Windows (**sites.google.com/view/sequator**).



Merge your photos to get a spectacular image showing Earth's rotation

ALL PICTURES: TOM KERSS

▲ A Moon that's low to the horizon can make a superb, but challenging, subject

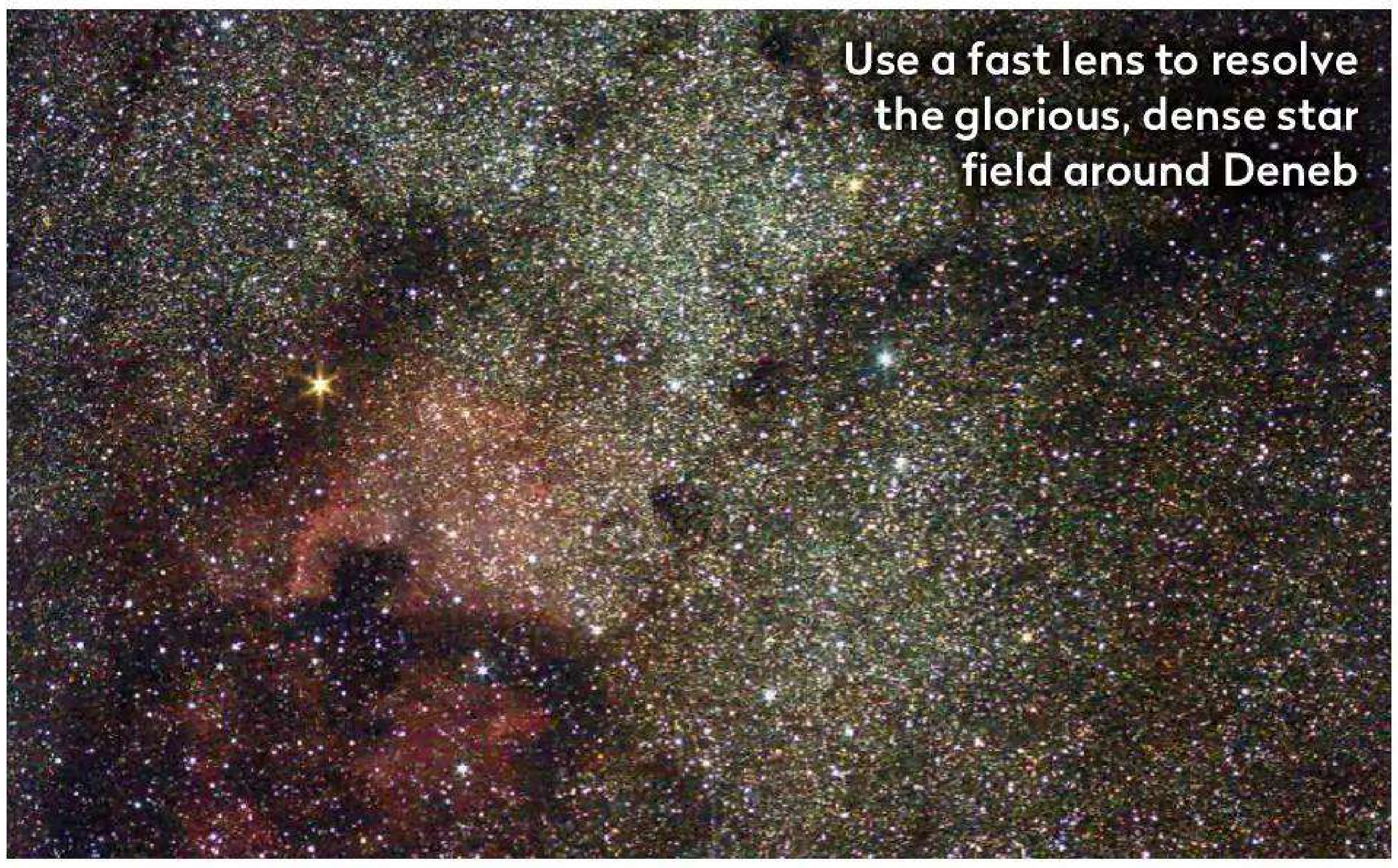
4. Two worlds together

Shooting both the Moon and Earth requires a little balance

Of course, our celestial companion makes a gorgeous subject for photography. The Moon is probably the easiest target in the sky – conspicuous and ever-changing, it offers many avenues for creativity. When the Moon is relatively low on the horizon, you can capture two worlds in one photo. Here you'll discover that the Moon appears very small through wide-angle lenses; consider using your longest lens to see how much detail you can tease out. The Moon shines in very bright contrast against a dark sky, which makes it challenging to frame among the stars. Underexposed shots will show the Moon's surface features but fail to bring out stars, whereas overexposed shots will recover stars at the expense of blowing out the Moon. An exception is possible during a fine crescent phase, where long exposures can simultaneously reveal stars as well as the Moon's faint night side, which is itself illuminated by the brightness of Earth.

Going deeper

A tracking device is an essential upgrade for astrophotography, allowing long exposures and longer lenses to bring out fainter details



Use a fast lens to resolve the glorious, dense star field around Deneb

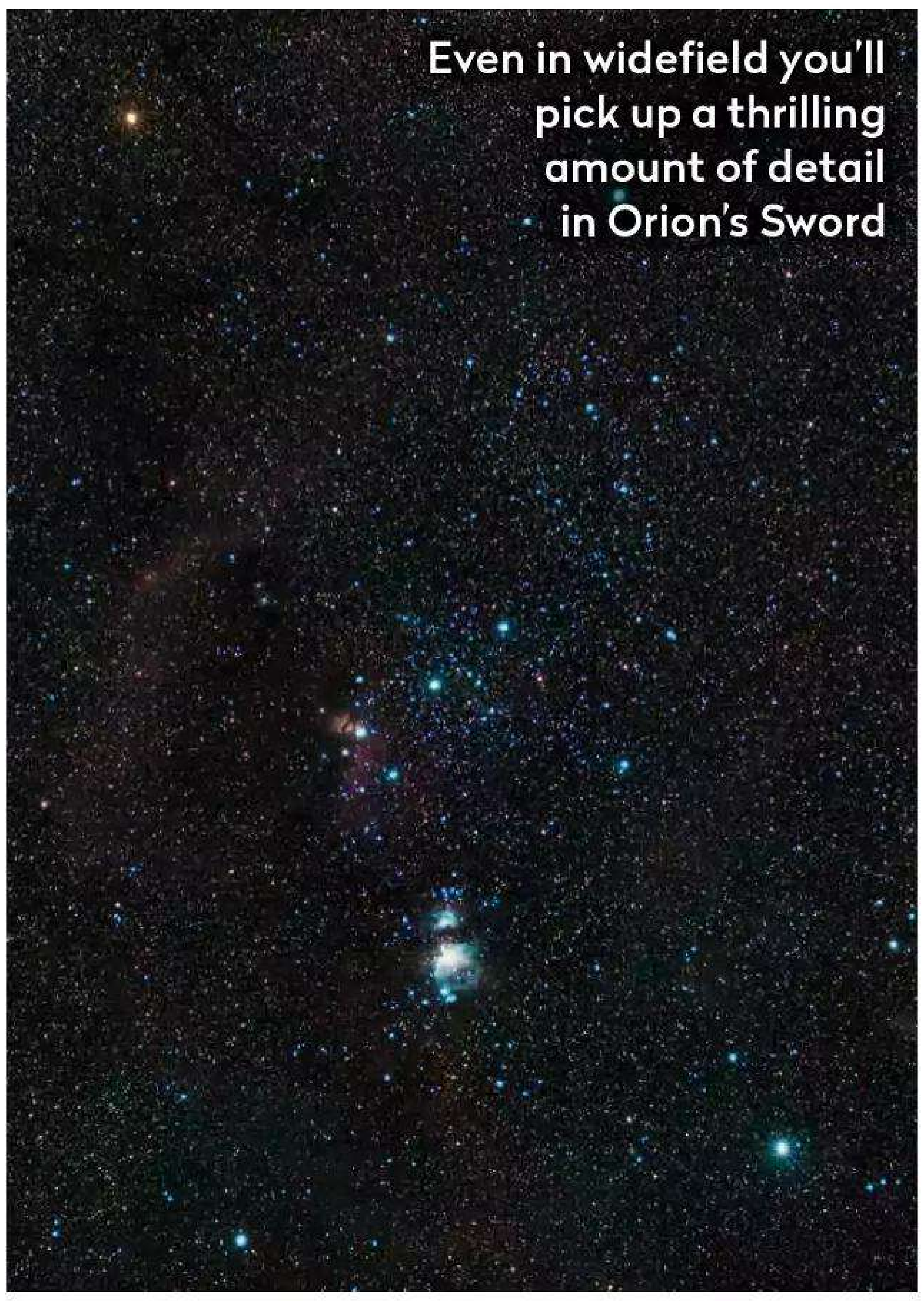
5. Star clouds in Cygnus

You can bring out even more detail by stacking together multiple images

The brightest region of the Milky Way is its core, but that only skirts our southern horizon; to us, the star clouds of Cygnus are more prominent. Gazing at the northeast of the Summer Triangle, you'll find yourself looking along the spiral arm we inhabit in the Galaxy. A rich concentration of distant light paints the scene around the brilliant star Deneb. On a tracking mount, use a fast telephoto lens to resolve the many stars. This subject provides a good opportunity to try aligning and stacking multiple exposures to reduce noise in your image. Try free tools such as Siril (macOS, Windows, Linux; **free-astro.org/index.php/Siril**) and DeepSkyStacker (Windows, **deepskystacker.free.fr**). Even if you're new to stacking, it's worth taking lots of images of each deep-sky target, as you'll be able to return to the data later on and produce better results with the benefit of your experience.

6. Jewels of Orion

The familiar constellation boasts a host of fascinating deep-sky objects

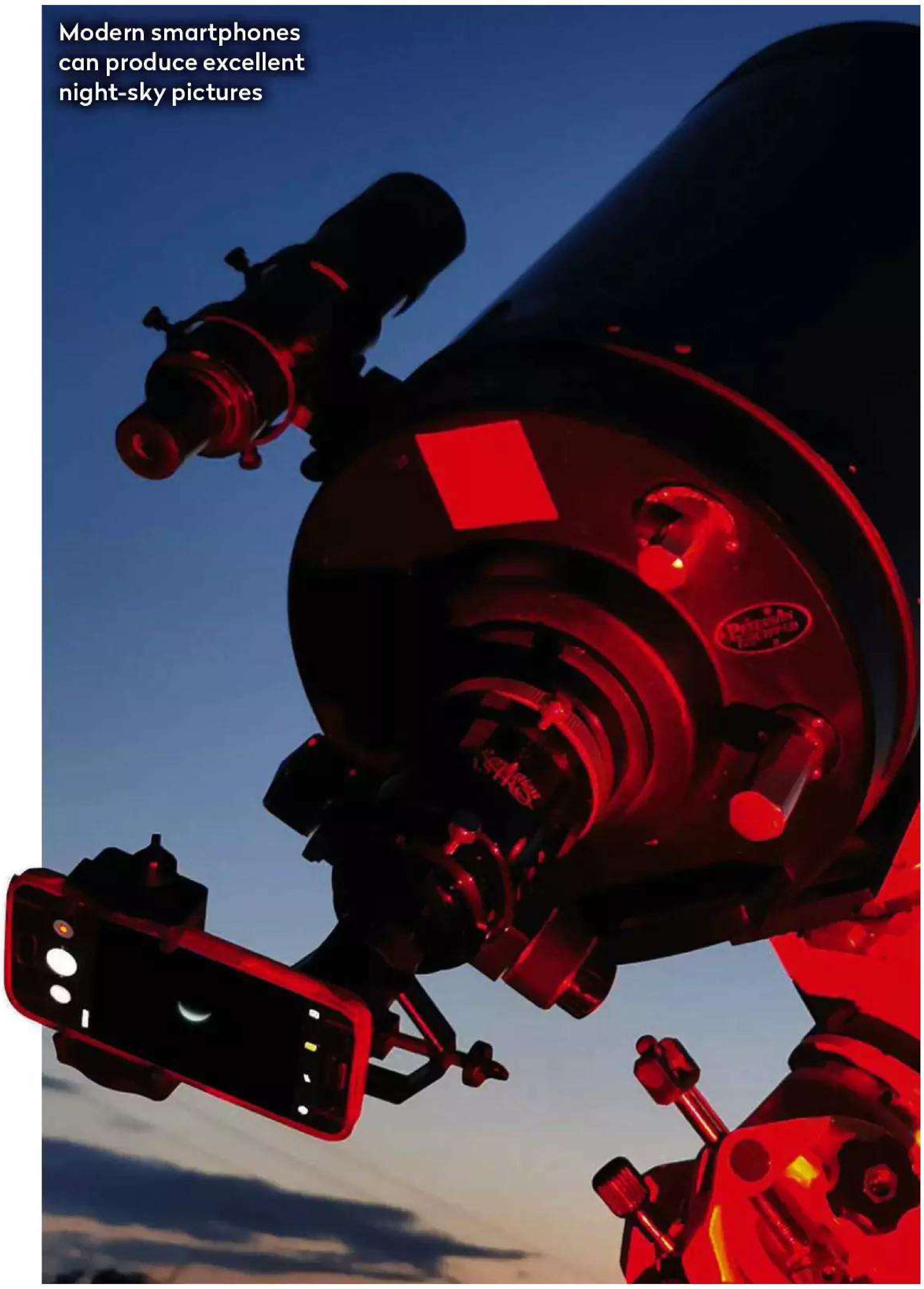


Even in widefield you'll pick up a thrilling amount of detail in Orion's Sword

The mighty Orion will be upon us soon as the autumn rolls around. A splendid tapestry of colourful stars and nebulous features, this constellation is home to a chain of objects called Orion's Sword. Among them is the Great Nebula in Orion (M42), which is conspicuous in photographs. Using a lens with a focal length of 50–70mm, you can generally frame the most interesting parts of the constellation fully, while also resolving some of the details that make the Sword so special. You may be surprised to see the iconic Horsehead Nebula (Barnard 33) clearly visible in your images. Orion's dramatic colours can be drawn out by stacking images, and correctly calibrated in tools like AstroPixelProcessor (macOS, Windows, Linux; **www.astropixelprocessor.com**). ▶

Snaps through the eyepiece

With a special adaptor, you can use your smartphone to snap quick shots through your telescope eyepiece



Modern smartphones can produce excellent night-sky pictures

With a high-power eyepiece, Venus's phases are a perfect target for a phone/telescope combo

7. The disc of Venus

Smartphones offer a quick, easy way to capture our closest planet's phases

Our nearest neighbouring planet, Venus, is a treat through a telescope. As Galileo first discovered over four centuries ago, it shows changing phases as it orbits the Sun. Among the planets, it can produce the largest and brightest disc as seen from Earth, and it's an ideal target for smartphone astrophotography practice. Use a high-power eyepiece (at least 50x magnification) and ensure your telescope is focused by eye, then swap to your smartphone. Your camera's autofocus may not produce good results, and it may also struggle to expose correctly for the high contrast of the scene. Consider using manual settings to control the exposure and focus. You may need to source an app to enable this. You should also shoot in your phone's raw image format where possible. Naturally, touching the phone will cause the telescope to wobble, so use a countdown timer, Bluetooth remote or – if your phone supports it – voice-activated shutter.

8. Jupiter and the Galilean moons

Capture the movement of the four moons around the gas giant

While Venus is essentially featureless in appearance (unless we use special filters and cameras), the Solar System's largest planet, Jupiter, has a very interesting face. Your phone's camera, correctly exposed, can reveal its various cloud belts, and larger storms including the famous Great Red Spot. Perhaps more compelling, though, are the four large moons that accompany Jupiter – the Galilean moons. At any given moment, up to four are visible flanking the planet, though one or more are often obscured by the planet or immediately in front of it from our perspective. Compared with Venus, you may find that longer exposures are needed to capture Jupiter, but these will be at most just a fraction of a second. Keep shooting, too – the blurring effects of astronomical seeing will be evident at high magnification, so some shots will be sharper than others.

Jupiter's moons are relatively easy to record as bright dots of light

PETE LAWRENCE, TOM KERSS X 4

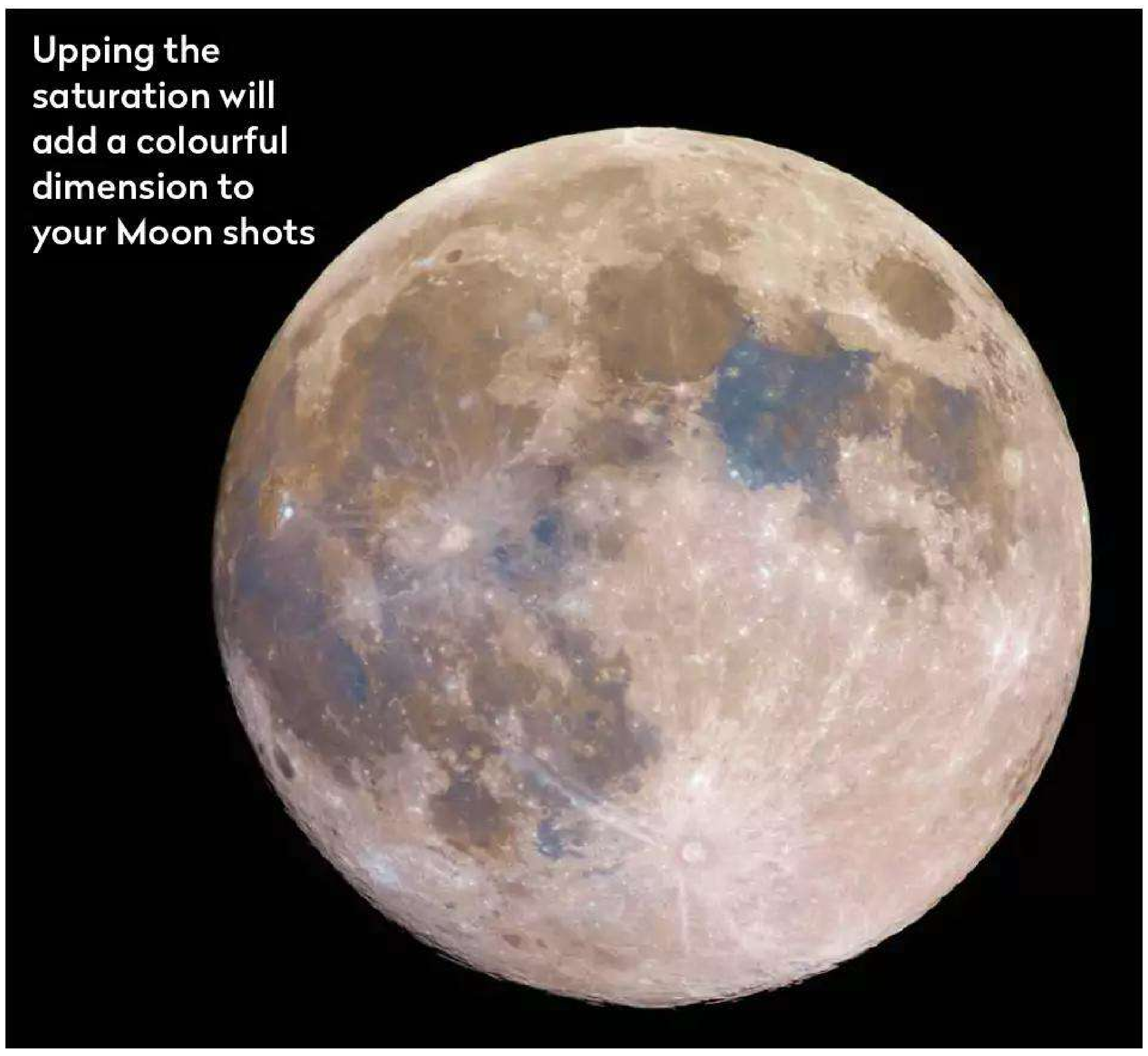
Your telescope is a lens

Many telescopes can be transformed into a giant lens by attaching a camera – including DSLRs and mirrorless cameras

9. The Moon up close

Combining your camera with a telescope can bring out a view of the Moon that's usually hidden

Even short telescopes are equivalent to powerful telephoto lenses, and longer scopes go far beyond the range offered by camera lenses. A 1.5m-focal-length telescope, for example, can project the face of the Moon across a DSLR sensor, almost edge to edge. With thousands of pixels sampling its rugged surface, remarkable details are revealed. Owing to its brightness, the Moon is a forgiving target at such long focal lengths. You don't need tracking (although it does help) to achieve great results. And it's not just spatial details that come into view. With high-resolution images of the Moon, we can draw out its subtle colours using image-processing software. By enhancing the saturation and vibrance of the image, we can see the chemical variance of the lunar surface. These colours are virtually imperceptible to the eye, even with a large telescope and lots of observing experience.

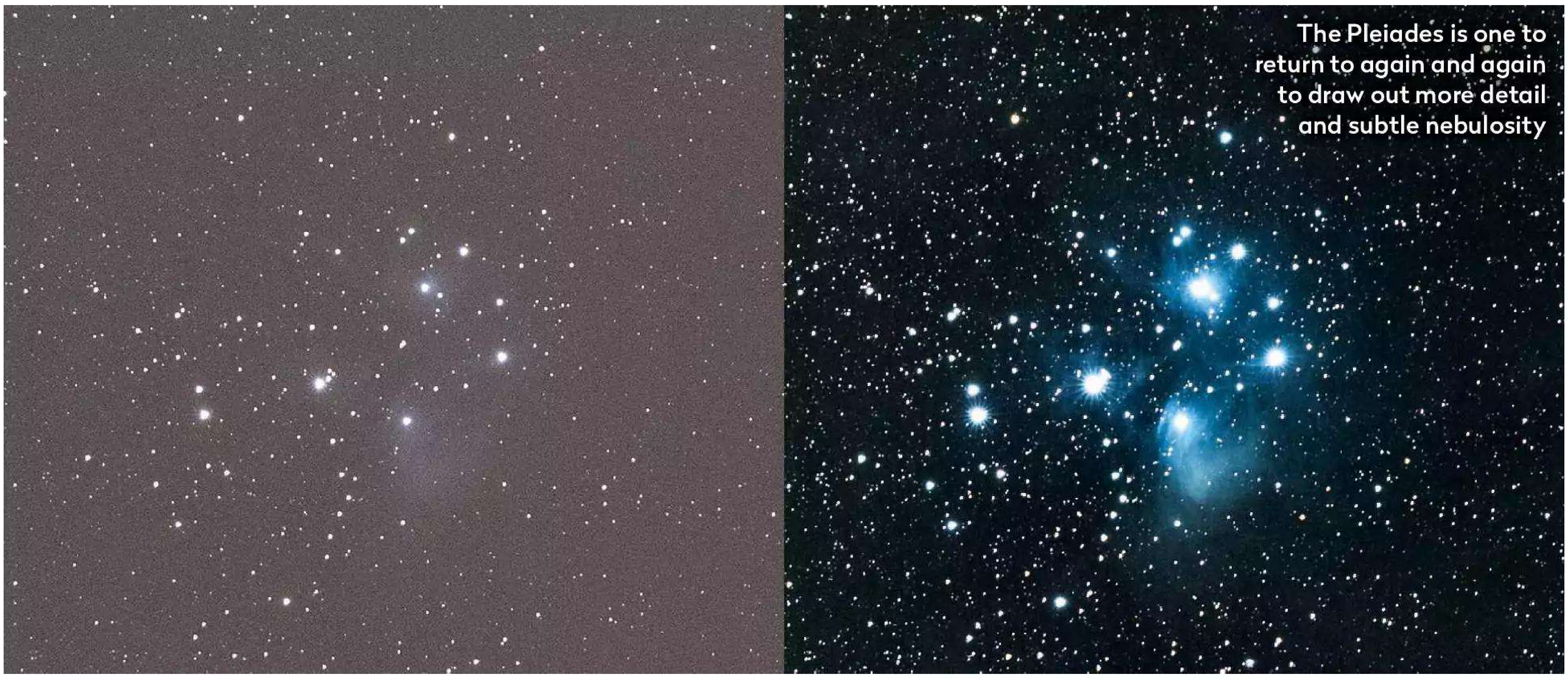


Upping the saturation will add a colourful dimension to your Moon shots

10. The Pleiades

With a powerful lens you'll be able to capture many of the Seven Sisters' siblings

As with our earlier look at deep-sky targets, a properly aligned tracking mount is essential when using your telescope to capture the stars, but the results are worth the effort. Using a fast, widefield telescope, you can turn your camera into a powerful astro-imaging tool, and the Pleiades star cluster is the ideal target to sharpen your imaging skills. The goal is to draw out fainter members of the cluster, the rich, blue colour of its prominent stars and the delicate reflection nebula in its vicinity. By practising your exposure stacking and image processing, you'll be able to turn out results that dramatically improve on anything offered by a single photo. Errors in tracking are punishing, but the Pleiades is one of the brightest deep-sky objects, and you'll be able to get away with exposures ranging from 10 to 30 seconds, depending on your telescope's aperture and camera ISO setting. Have fun experimenting, and good luck with your first steps in astrophotography!



The Pleiades is one to return to again and again to draw out more detail and subtle nebulosity

UWA 82° FMC
Nirvana™ ES 13mm UWA 82°
UWA 82° FMC
Nirvana™

Well-chosen eyepieces can bring out the best from your telescope, make astronomy a real pleasure and take your observing from mediocre to mind-blowing

Build your EYEPIECE COLLECTION

Great eyepieces are crucial to any astronomical setup. Here **Tim Jardine** arms you with the info you need to choose the best ones to invest in

Many new telescope packages come with a basic eyepiece or two, good enough to help you get started with the hobby and familiarise yourself with your equipment. Plenty of experienced astronomers will hold fond memories of their first view of Jupiter or Saturn through these starter eyepieces. But it doesn't take long until you start wondering… how much better would the view be through a different lens?

It's fair to say, though, that the choices on offer can be bewildering. Especially given the nomenclature: you might hear of Plössls, orthoscopics, radians and Naglers, or even Kellners and Erfles, and find each costing anywhere between £25 to an eye-watering £1,000 plus – which is perhaps more than the telescope itself!

However, if you can decipher all these terms, you should be able to build a well-chosen selection of four or five eyepieces that will provide high-quality views of everything the night sky has to offer for many years to come. ▶

Tim Jardine is an experienced astronomer and a seasoned telescope tester for *BBC Sky at Night Magazine*

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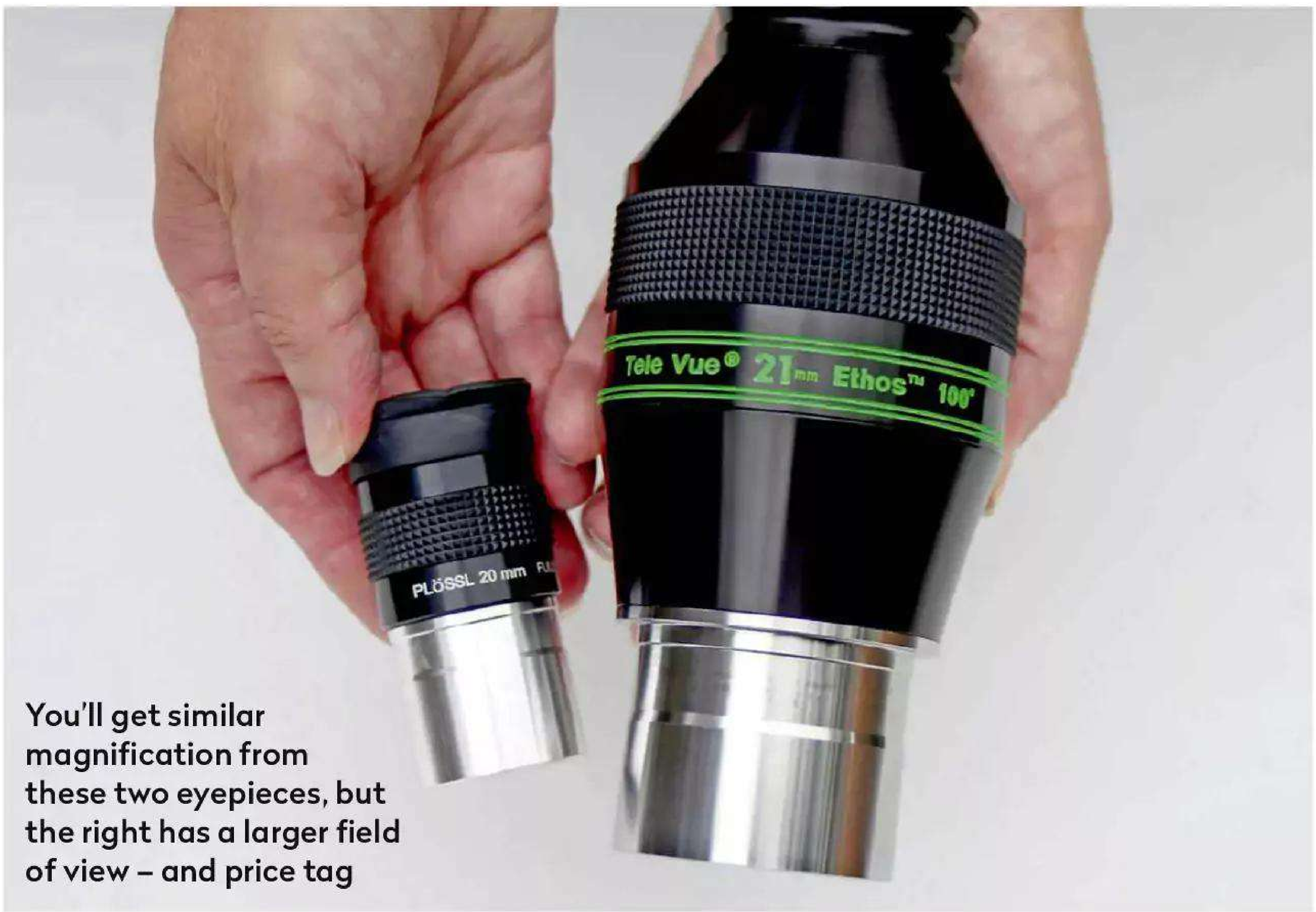
Types of eyepiece

Wide fields of view offer an immersive, but expensive, option



You'll get similar magnification from these two eyepieces, but the right has a larger field of view – and price tag

There are a great many types of eyepiece on offer, but essentially, the difference between them is the apparent field of view. This is measured in degrees as seen by the observer. The human eye can see around 180° in the horizontal plane, and so the closer to this an eyepiece gets, the more immersive your viewing experience will be. Generally, the wider the view on offer, the more complicated the eyepiece's design and the higher the price.

At the narrower end of the scale, orthoscopic and Plössl designs offer around 40° and 50° views respectively, and are popular for smaller targets, such as planets, lunar craters and double stars. As a middle-of-the-road option, there are a good variety of lenses available between 62° and 82°, such as those on offer in the Pentax XW and Baader Morpheus ranges, which can provide very comfortable wider views.

The premium end of the market is occupied by the ultra-wide eyepieces from Explore Scientific and Tele Vue, offering absorbing 100–120° views through complicated, heavy lenses. These can really draw you into the scene with breathtaking visuals, but at considerable cost. Wide-view eyepieces are especially useful when observing extended nebulae, large galaxies and open star clusters.

Another factor you'll need to consider is focal length, sometimes described as the eyepiece's 'power'. This determines the magnification you'll see, which means a 10mm 40° eyepiece will offer the same magnification as a 10mm 100° eyepiece. You should always be able to find the focal length of an eyepiece written on its side, in millimetres. We'll cover how you can work out the magnification later, but as a quick guide: the lower the focal length, the higher the magnification.

A 10mm Plössl will give detailed views of things like lunar craters

5mm Delos™
Tele Vue® 21mm Ethos™ 100°
FULLY COATED
FULLY MULTI-COATED
28mm
Multi-coated

▶ Focal length, field of view, magnification and budget are all considerations when building your collection

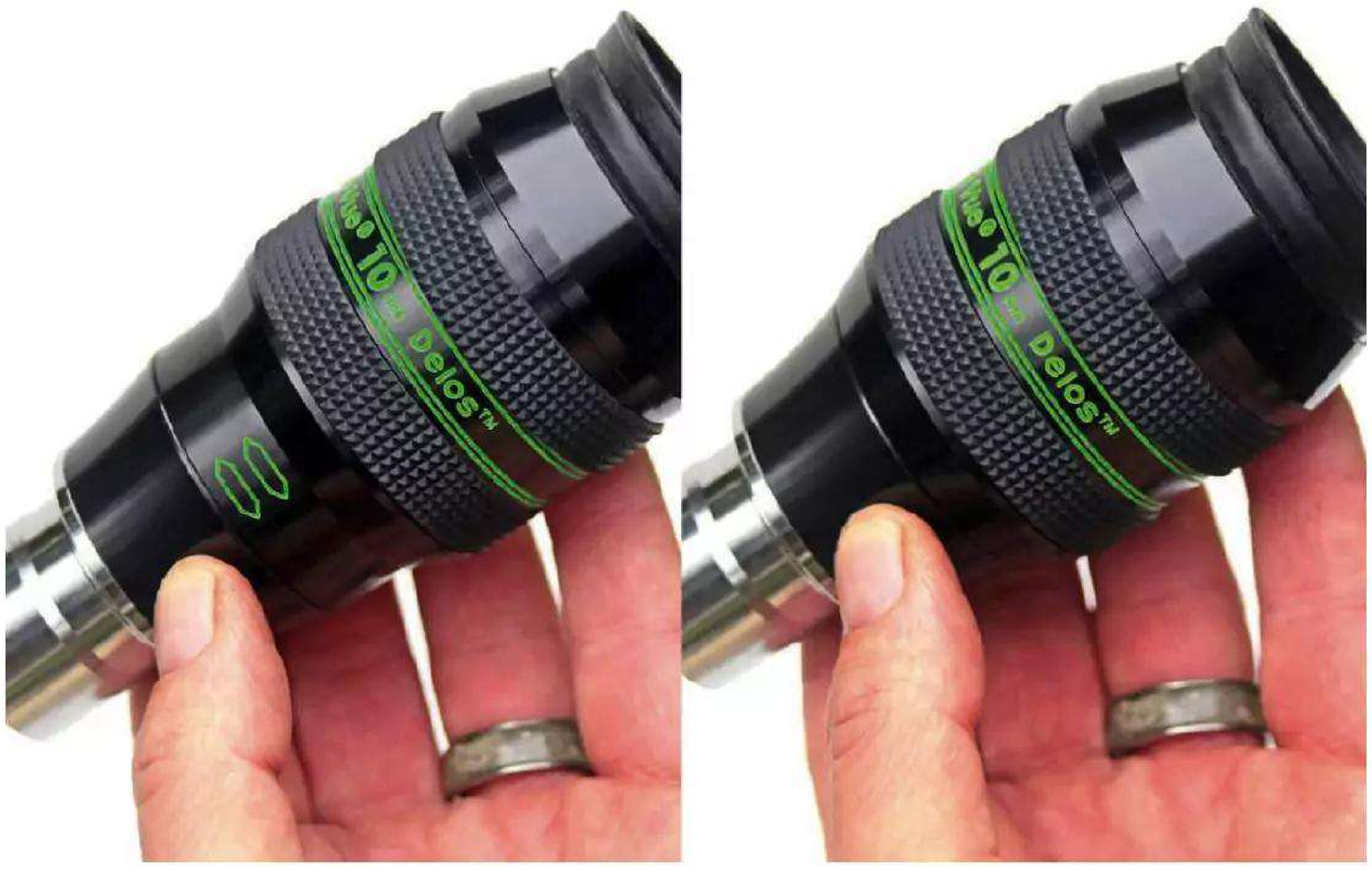
While the preferred field of view can be a matter of personal taste, your telescope will have a much bigger say in which focal lengths are suitable. There's no point trying to force huge magnifications from telescopes that can't support them. In theory, the aperture of a telescope, measured in millimetres, can be doubled to give you a maximum magnification. For example, a 100mm-aperture telescope can be taken up to a magnification of 200x, and a 200mm up to 400x.

In practice though, the maximum usable magnification is limited by Earth's turbulent atmosphere. Even on the very best nights of good seeing, 250x is about as high as you'll go for most observing, no matter the telescope size. When building your collection, it's sensible to start with a range of usable magnifications, realistically between 40x and 180x.

TIM JARDINE X 6, STEVE MARSH

Sky-Watcher
TELESCOPE

▲ A 2-inch eyepiece is likely costlier but usually offers extended eye relief and more comfortable observing



▲ In addition to flip-down rubber eye cups for glasses wearers, some eyepieces have an extendable twist-and-lock barrel to personalise the eye relief setting

Quantity or quality?

Finding the right fit for you isn't always just about the price

Experienced observers will likely state that they would rather have one or two good-quality eyepieces than a case full of inferior ones. Often a favourite lens comes to the fore, becoming the go-to tool for most observation. But it does not necessarily follow that the most expensive unit is the preferred one.

Seemingly little things can make all the difference. Better eyepieces will be described as fully multi-coated, referring to the non-reflective coatings applied to the lenses. These coatings improve the contrast of your view by reducing reflections within the eyepiece. Consider too the actual build of the eyepiece. How does it feel in your hands? Does it have a rubberised element on the body to help with grip? As they will be used with cold hands in the pitch black, you'll want an eyepiece that's not too slippery or easy to drop. Do the end caps fit well and stay on? Are the rubber eye-guards soft and comfortable? Are they replaceable?

If your telescope focuser supports the use of 2-inch eyepieces, you will find that they offer a better, more user-friendly view at longer focal lengths. They cost more, but you should find it's soon offset by more enjoyable hours using them.

Another factor that determines the comfort of your viewing experience can be the eye relief a given eyepiece offers. Eye relief describes the distance from the rear of the lens to the point that presents the maximum image circle – basically, how close you have to get your eye to the eyepiece. This can be a quite individual element of observing. Even when figures are quoted for eye relief, it is more practical to actually use an eyepiece to discover whether or not it will be agreeable to observe with for an extended time. When purchasing, it can be prudent to check the returns policy of the retailer.

Glasses wearers in particular will find eye relief an important factor. Short- and long-sighted astronomers can usually adjust for their eyesight with focusing, avoiding the need to wear glasses when observing. However, those with astigmatism will need to wear their glasses, and so may find eyepieces with adjustable-length barrels and longer eye relief are more comfortable. It is also possible to purchase special lenses for Tele Vue eyepieces that adjust for astigmatism and remove the need for glasses. In that case, seeking the advice of a knowledgeable dealer is recommended.

Social media provides a wealth of experienced opinions that can prove helpful when choosing a new eyepiece, or deciding which one to save for. Astronomy forums can be a great source of advice too. Try asking: "My telescope is an XYZ model. If you could choose one eyepiece for it, which would it be?". Hearing real-world recommendations from existing users can be invaluable, especially when they can recommend a budget eyepiece with solid performance or explain the reasons they feel it's worth investing in the high-end examples with the hefty price tags. ▶

The pitfalls of zoom eyepieces

Zoom eyepieces can be twisted to adjust their focal length, offering a range of magnifications from just the one ocular. If they could offer great views, then a zoom eyepiece would be all that was needed. But unfortunately, this isn't the case – the ability to quickly switch between magnifications leads to optical compromises.

A dedicated eyepiece will almost always provide a better view at comparable focal lengths. Zoom oculars can be useful when starting out, to help decide optimal magnifications with your telescope, or perhaps in a shared viewing session if you don't want to keep switching eyepieces. In general, though, once you build your collection, a zoom lens tends to get less and less sky time.

8
stop-Zoom 8-24mm
MARK III

▲ One-lens solutions may cut down faff, but optical quality may be the trade-off

▲ A medium-power 15–25mm eyepiece is suited to deep-sky objects like M13 (top) and M57 (bottom)

▲ For large galaxies like Andromeda (above) or the full disc of the Moon, long-focal-length eyepieces of 25–35mm will fit the whole scene in the field of view

Choosing which eyepiece to use

Having the right one ensures your observing will turn out alright on the night

Many of us start out by observing the so-called 'lollipops' of our Solar System, bright, easy-to-find objects like the Moon, Saturn and Jupiter. For the deep sky, it's the brighter Messier objects, such as M13, the globular cluster in Hercules, or M57, the enchanting Ring Nebula in Lyra which draw the most attention.

While you're attempting to locate these objects, it can be useful to have a wider view. Once pinpointed, you can swap to a higher power with more magnification to see more detail on the lunar surface or planets. Meanwhile, these same eyepieces will make deep-sky objects like M57 stand out more at higher magnification because the background sky appears darker.

So as a minimum, two eyepieces would seem to be essential. When new telescopes come bundled with eyepieces, they typically include two: a wider view lens in the region of 15–25mm focal length and a higher power one in the 5–10mm range for more magnified views.

It's worth remembering that higher magnification doesn't always mean better views. Of course, some targets are quite large, such as the Double Cluster in Perseus, or the enormous Andromeda Galaxy. A more pleasing view of these can be obtained from a wide view, and longer-focal-length lenses, perhaps 25–35mm, can really allow an enjoyable, low-magnification view that encompasses broader objects in full, or allows you to see smaller objects in the context of their surroundings.

▶ Off-the-shelf scopes typically come with a pair of basic starter eyepieces

PLÖSSL 9 mm
PLÖSSL 20 mm

With such a huge variety of deep-sky options, having a collection which covers the whole range, but is biased towards the type of target you find most appealing, makes a lot of sense. For example, if you appreciate the odd star cluster but spend more time on Jupiter's details, then leaning to shorter-focal-length oculars will allow you to get a close look at the details which the best-view sky conditions allow. Meanwhile, if hunting out distant galaxies is your thing, you will find that a range of lower-magnification wider views provide the sweet spot.

What about a Barlow?

Barlow lenses are combined with an eyepiece to increase magnification by the factor indicated on the barrel. Most common are 2x and 3x Barlows, and with a bit of thought they can effectively double your eyepiece collection. Bear in mind, doubling the magnification means halving the eyepiece's focal length, so with a 2x Barlow lens a 30mm eyepiece acts like a 15mm, whereas a 3x Barlow would decrease it to 10mm.

▶ A Barlow can be a great investment, cleverly doubling the magnification of eyepieces you own

Tele Vue® 2x
2×
3×

FRANZ KLAUSER/CCDGUIDE.COM, GÜNTER KERSCHHUBER/CCDGUIDE.COM, HORST ZIEGLER/CCDGUIDE.COM, TIM JARDINE X 3, WWW.ASTRONOMY.TOOLS

Tools to help pick an eyepiece

Don't worry if you're getting lost in numbers – there are tools to help

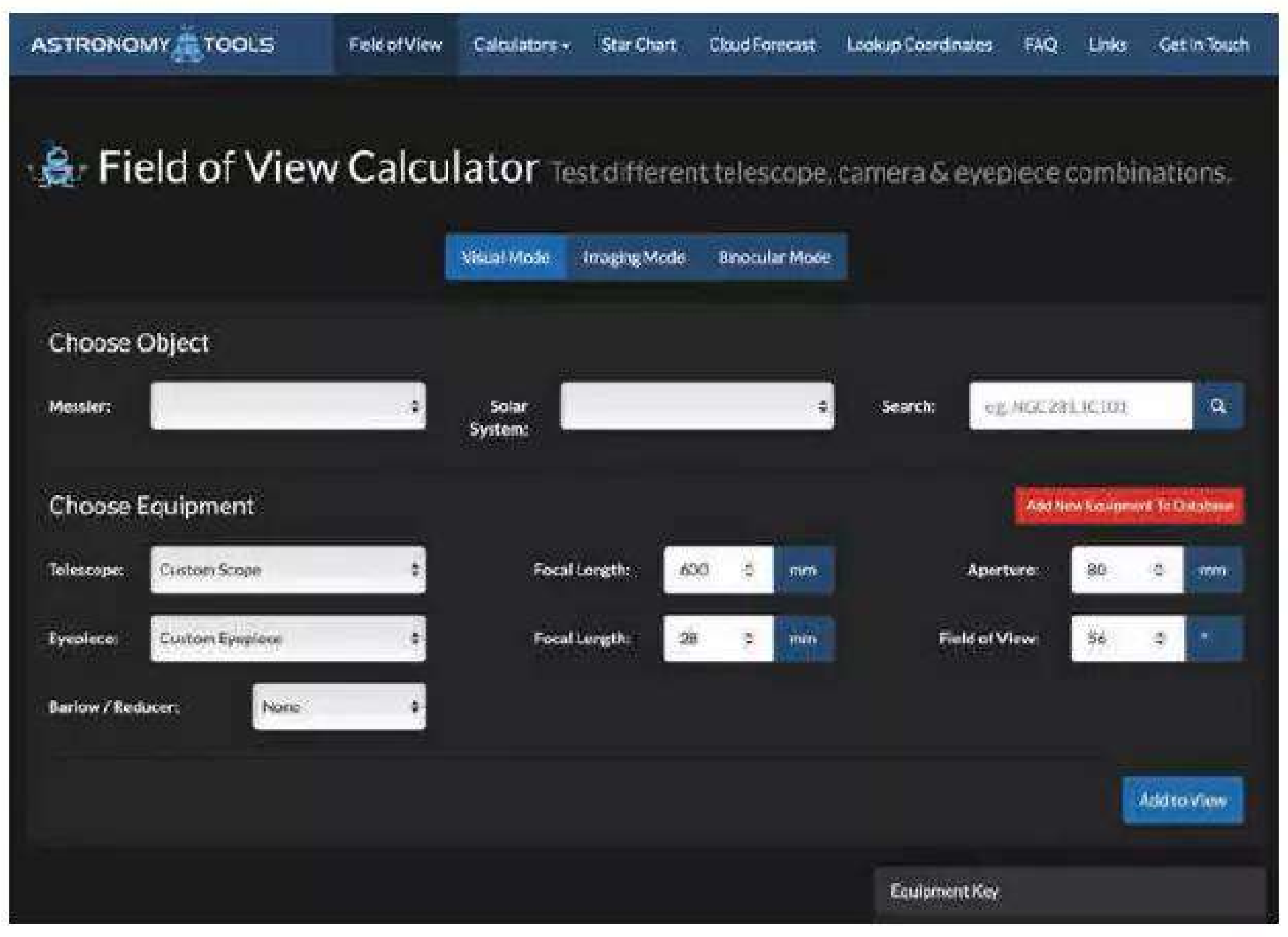
To work out the magnification of an eyepiece you just divide the focal length of your telescope by the focal length of your eyepiece. However, there are other useful figures to consider when determining how an eyepiece will perform, such as the field of view on offer.

Another factor is the size of what is known as the exit pupil, which in basic terms is the size of the disc of light emerging from the rear of your eyepieces. To work this out, you'll need the aperture of the objective lens of your telescope, which should be written on it, perhaps labelled as 'D'. Take this number and divide it by the magnification of your eyepiece. For most observing, an exit pupil of 2–7mm is most comfortable as that roughly matches the pupil diameter of your own eye. On nights of good seeing, you may be able to push boundaries even lower for observing smaller details on planets. However, any eyepiece or Barlow combination presenting an exit pupil smaller than 0.5mm should be avoided.

TELESCOPE
D=150mm F=750mm
Coated Optics
Made in China

▲ **Find out the aperture of your telescope's objective lens to work out its exit pupil size**

Thankfully, there are online tools and calculators available which make it very easy to gather all the necessary figures and use them to compare eyepieces against each other. You can find one at **www.astronomy.tools**, along with other useful, free astronomy tools. Its field of view calculator has a visual representation of what you will see in any given eyepiece and telescope combination, and lists the magnification, effect of a Barlow, exit pupil size and so on.


ASTRONOMY TOOLS
Field of View
Calculators
Star Chart
Cloud Forecast
Lookup Coordinates
FAQ
Links
Get In Touch
Visual Mode
Imaging Mode
Binocular Mode
Add New Equipment To Database
Add to View
Equipment Key

Field of View Calculator Test different telescope, camera & eyepiece combinations.

Choose Object

Messier:

Solar System:

Search: e.g. NGC 281, IC 101

Choose Equipment

Telescope: Custom Scope

Focal Length: 600 mm

Aperture: 80 mm

Eyepiece: Custom Eyepiece

Focal Length: 28 mm

Field of View: 56 °

Barlow / Reducer: None

▲ **There's a very useful free field-of-view calculator at www.astronomy.tools**

Completing your set

When it comes to eyepieces, it's about what works best for you

Tele Vue® 4.5mm Delos
Tele Vue® 10mm Delos
Tele Vue® 13mm Ethos
Tele Vue® 21mm Ethos
Tele Vue® 31mm Nagler Type5
Tele Vue® 2x POWERMATE
Tele Vue®

▶ **Whether you colour-coordinate or just mix and match, your collection will be very personal to you**

With all these elements taken into consideration – field of view, focal length, eye relief, exit pupil, barrel size, observing type and so on – an eyepiece collection becomes a very personal thing, tuned to your individual requirements, equipment and preferences. However, there is always room for more options, and even though it can only be enjoyed during daylight hours, there is something deeply satisfying about matching sets of eyepieces, and even in matching the colour trim of the eyepiece to the telescope! Whichever direction your tastes dictate, a well thought-out eyepiece assortment will keep you coming back to the telescope, and allow you to relish all the delights of the night sky.

Take the Caldwell challenge

Follow in the footsteps of Patrick Moore and track down 10 favourite targets from the deep-sky catalogue he created

The nights of late winter and early spring are ideal for discovering a deeper view of the stars, something well known to *The Sky at Night Magazine*'s late Editor Emeritus, Patrick Moore. He was ever keen to encourage everyone to look up at the night sky and out into the cosmos, which is why he compiled his very own Caldwell Catalogue.

This challenge we've put together is based on this catalogue of deep-sky objects, from which we've selected 10 of our favourite objects for you to tour, all of which are visible between January and March. Your task is to find them all in a single observing session. Some of the targets are quite popular, and you'll have seen them in *The Sky at Night Magazine*'s monthly deep-sky and binocular tours, while others are a little less well-known. Hopefully you'll be discovering some of these for the first time.

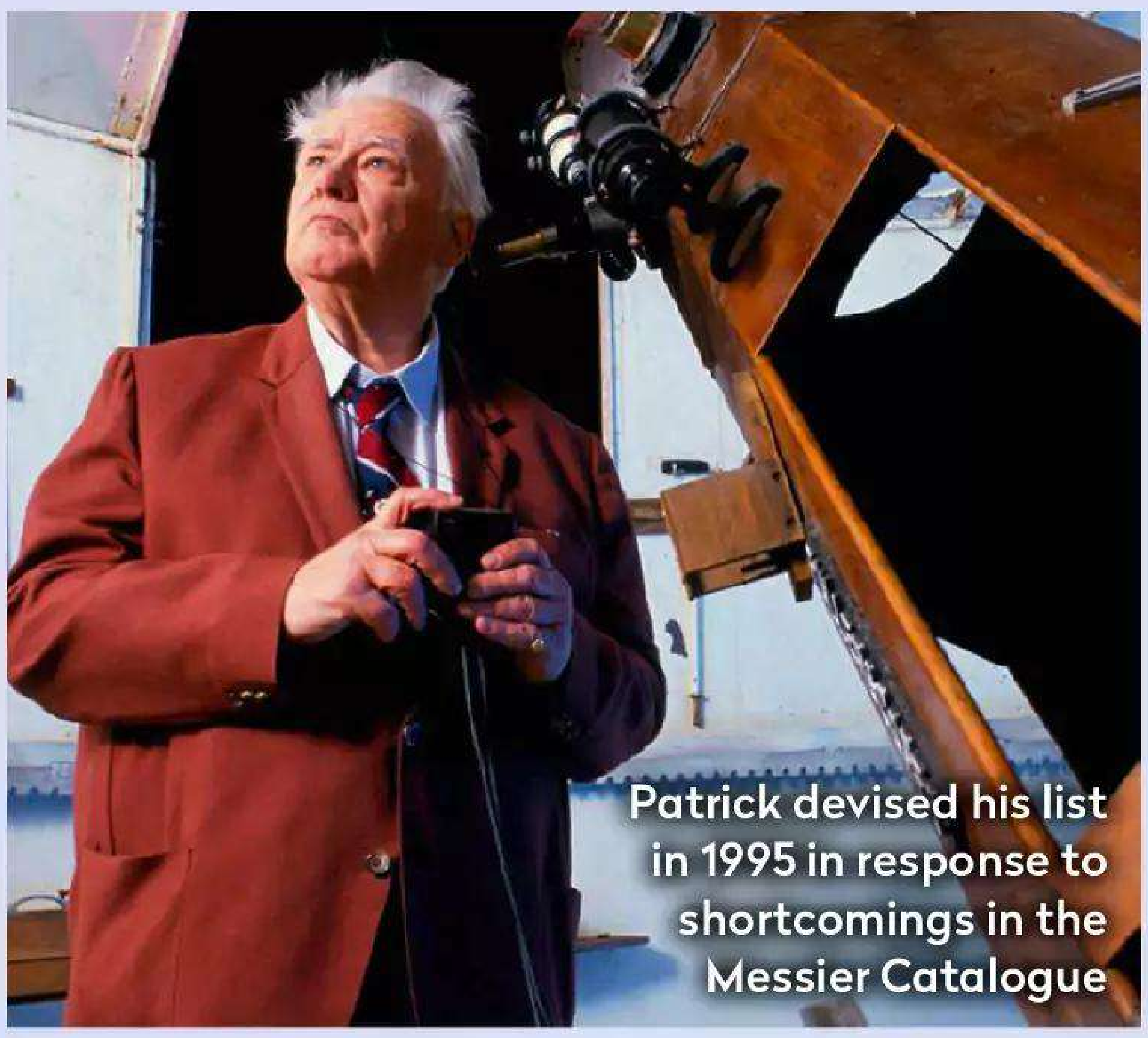
The minimum size telescope for this challenge is a 4-inch refractor: all of the objects are within reach of this size instrument under dark skies. Larger apertures will certainly help, of course, revealing hidden details that may otherwise elude you.

We suggest that you attempt the challenge a few days either side of new Moon, to avoid interference from the Moon's light. New Moon in January 2025 is on the 29th; in February it's on the 28th; and in March it's on the 29th.

Don't be caught out by a cold snap and be sure to wear suitable warm clothing and have some hot drinks on hand. Why not involve some friends and their telescopes in the challenge and make this a social occasion too? ▶

The making of Moore's marathon

Why did Patrick produce his own celestial catalogue, and what targets does it contain?

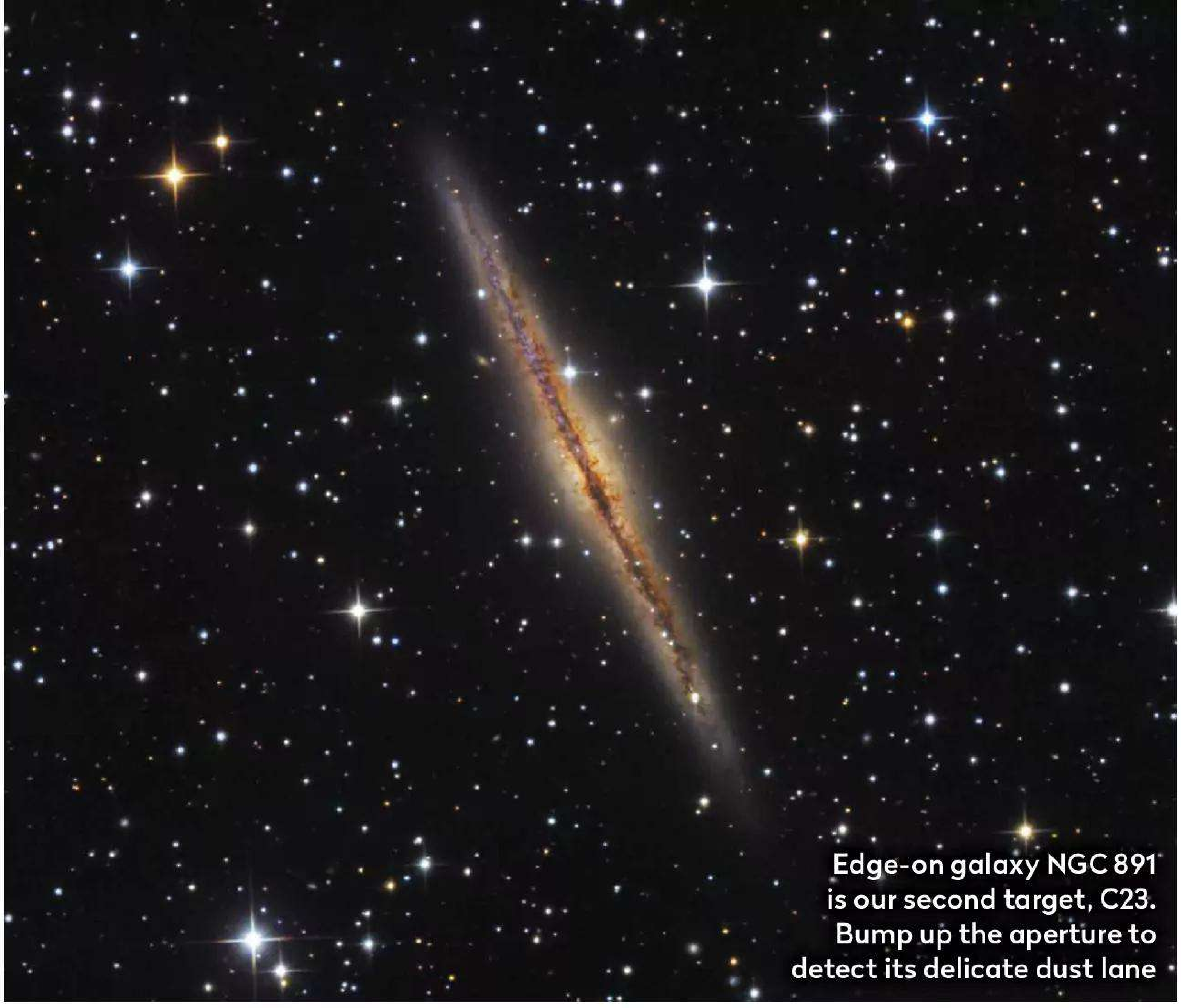


Patrick devised his list in 1995 in response to shortcomings in the Messier Catalogue

The Caldwell Catalogue came about because Patrick felt that the Messier Catalogue – a list of 110 objects originally created to tell comet hunters what to *avoid* – was somewhat incomplete. So he drew up a list of his favourite objects, all absent from Charles Messier's magnum opus. With the 'M' of Moore already taken, Patrick opted to use the 'C' of Caldwell for the objects in his list (his full surname being Caldwell-Moore). Patrick's catalogue contains 109 objects that, unlike Messier's, are spread across both the Northern and Southern Hemispheres. It includes 28 open clusters, 18 globulars, 35 galaxies, 13 planetary nebulae, 12 bright nebulae, one dark nebula and two supernova remnants, arranged in order of declination.

HOMER SYKES/ALAMY STOCK PHOTO, ROLF GEISSINGER/CCDGUIDE.COM

The magnificent Flaming Star Nebula or Caldwell 31, one of our top 10 picks from Patrick's Caldwell Catalogue



Edge-on galaxy NGC 891 is our second target, C23. Bump up the aperture to detect its delicate dust lane

1. NGC 752

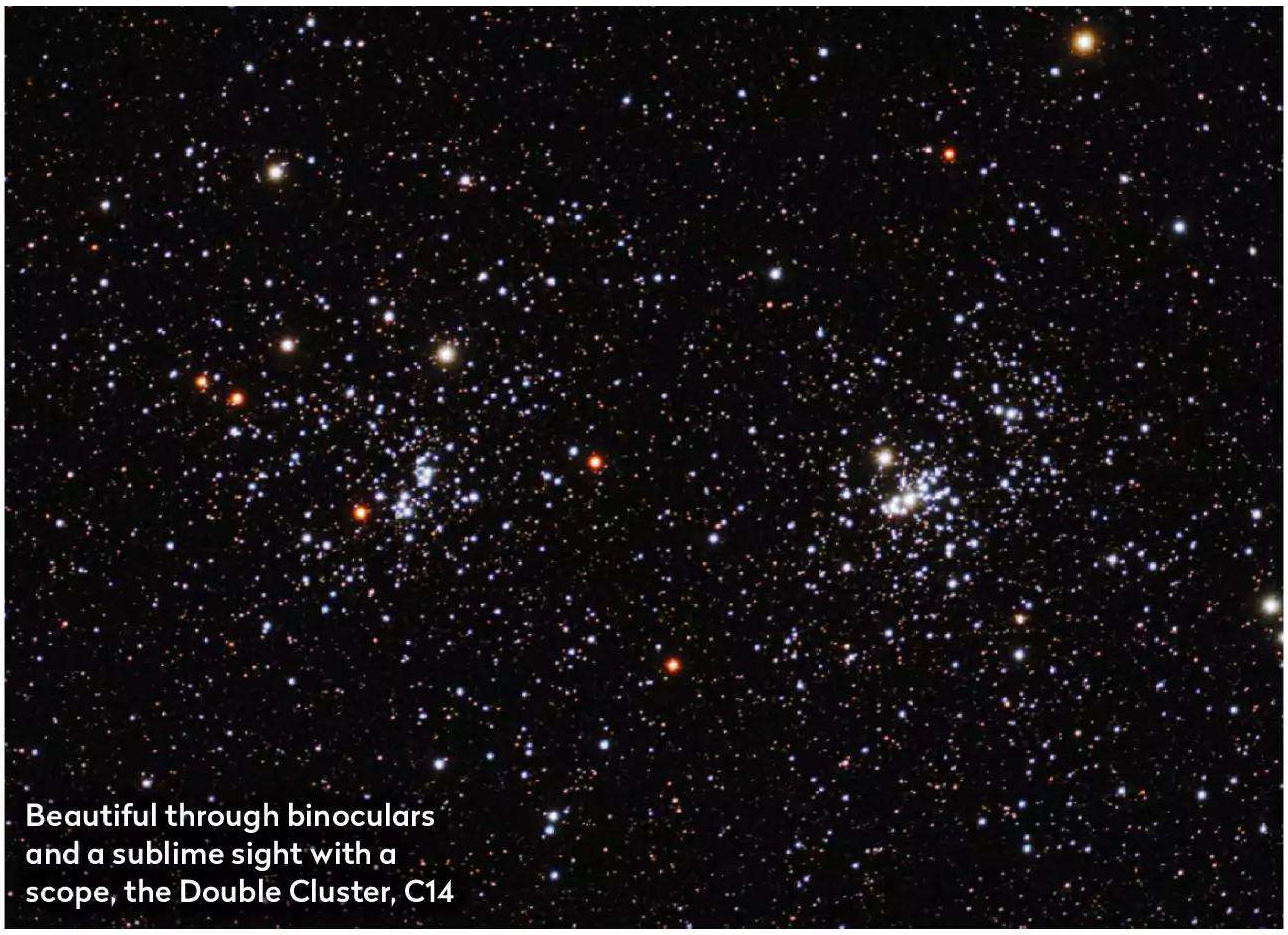
Also designated: C28
RA 1h 56m 53s, dec. 37° 47' 38"

We start our challenge with a fine binocular object originally discovered by Caroline Herschel in 1783. Open cluster C28, also known as NGC 752, lies about one-third of the way between mag. +2.3 Almach (Gamma (γ) Andromedae) and the apex star in the constellation of Triangulum, mag. +3.4 Mothallah (Alpha (α) Trianguli). It can be easily found by sweeping between the two stars and, at almost two billion years old, this is one of the oldest star clusters known. Binoculars will show in the region of 30 widely scattered stars, although a rich-field telescope at low magnification is the best way to really enjoy this lovely object, revealing in excess of 60 individual member stars, more than a dozen of which are brighter than mag. +10.0.

2. NGC 891

Also designated: C23
RA 2h 22m 36s, dec. 42° 21' 00"

Moving nearly 7° northeast now, your second object lies one-third of the way along a line joining the stars Almach and mag. +2.1 Algol (Beta (β) Persei). We're looking for mag. +9.9 edge-on galaxy NGC 891, and although it is visible in a 4-inch telescope, its low surface brightness means you may need to use averted vision. It is worth lingering here a little, as more and more detail will be revealed as your eye becomes accustomed to the view. If you can increase your aperture and up the magnification to around 120x, with careful scrutiny you should discern a slender dark dust lane bisecting the galaxy. This object was originally discovered by William Herschel in 1784, and it is believed to be over 30 million lightyears away from us.



Beautiful through binoculars and a sublime sight with a scope, the Double Cluster, C14

▲ The Owl Cluster, C13 in Patrick's list, should be an easy hop from Ruchbah

MICHAEL BREITE/STEFAN HEUTZ/WOLFGANG RIES/CCDGUIDE.COM X 2, BERNHARD GOTTHARDT/CCDGUIDE.COM, BERNHARD HUBL/CCDGUIDE.COM, CHART BY PETE LAWRENCE

3. Double Cluster

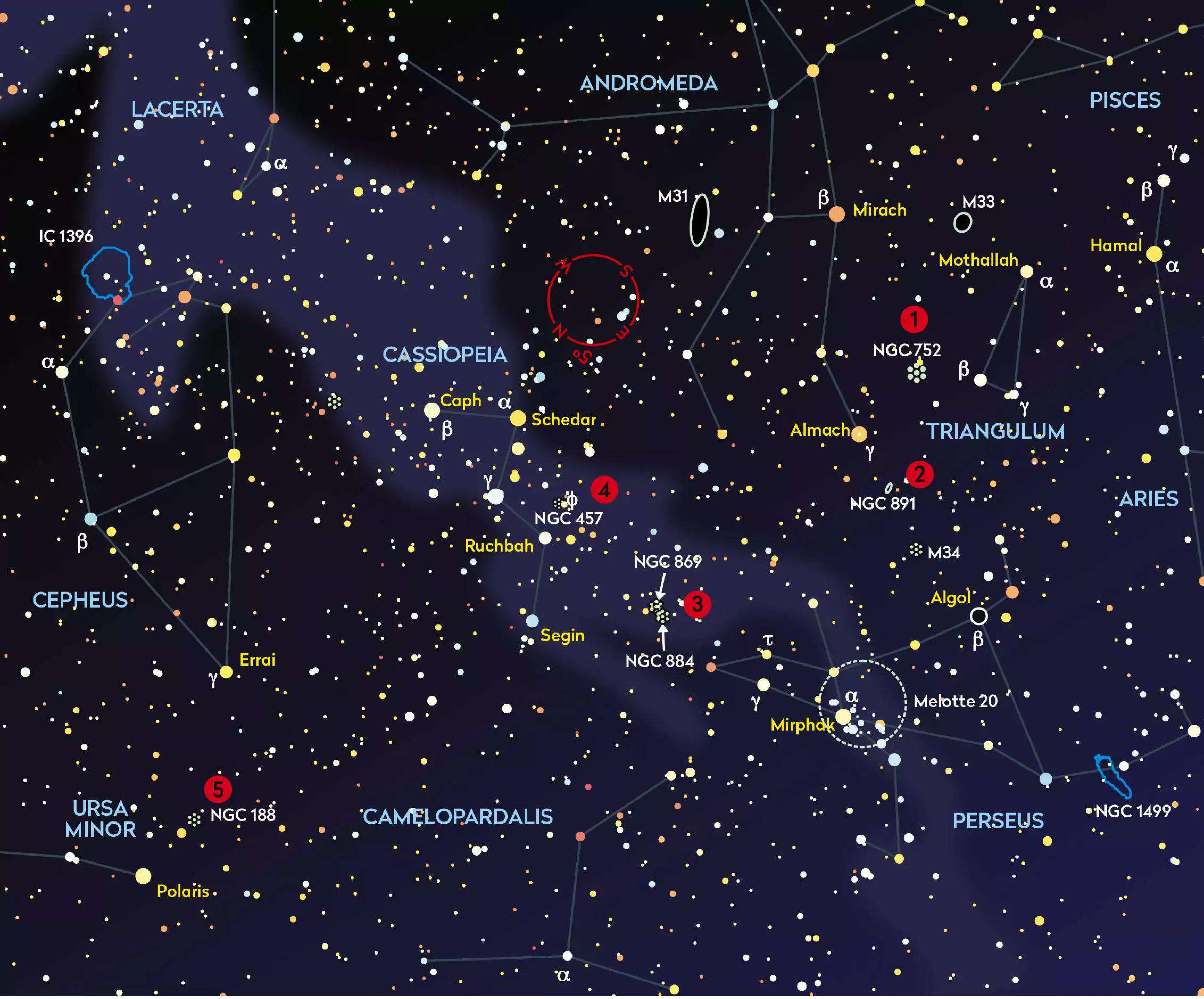
Also designated: C14, NGC 869 & NGC 884
RA 2h 19m 00s, dec. 57° 9' 00"

Continuing our journey into Perseus, your next target is a real treat: two objects for the price of one! NGC 869 and NGC 884 are popularly known as the Double Cluster today; in antiquity it was the Sword Handle, referencing the jewel-encrusted sword given to Perseus by Athena and Hermes to help him behead the Gorgon Medusa (the latter is represented by the star Algol). The individual clusters are a fine sight through binoculars and can be seen with the naked eye from a dark location. A binocular sweep between mag. +3.9 Tau (τ) Persei and mag. +2.7 Ruchbah (Delta (δ) Cassiopeiae) will easily find them. NGC 884, the more easterly of the two, contains numerous white-blue stars, whereas NGC 869 is dimmer and more compact.

4. The Owl Cluster

Also designated: C13, NGC 457
RA 1h 19m 6s, dec. 58° 20' 00"

We leave Perseus and continue into Cassiopeia, a constellation named after a

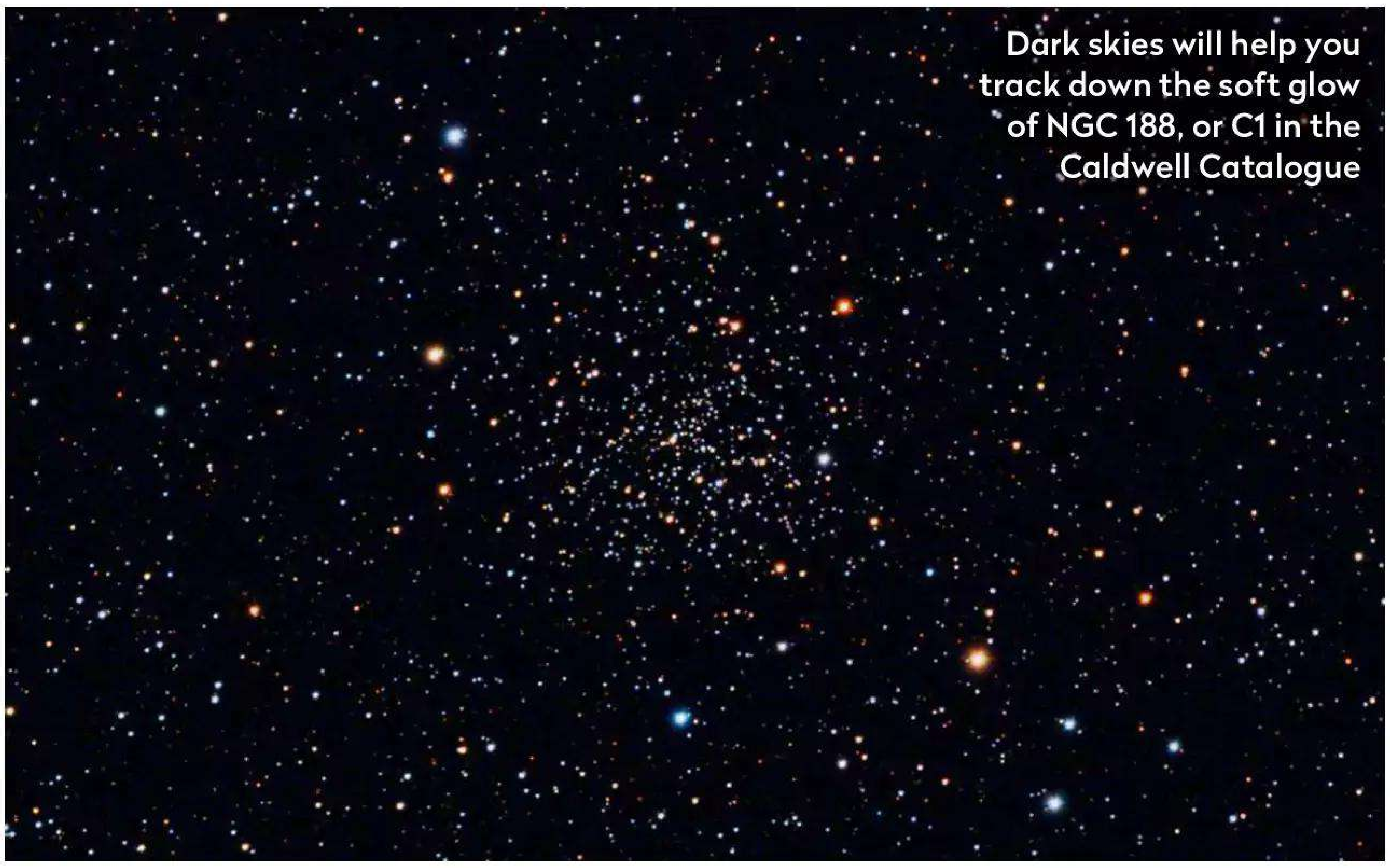

ANDROMEDA
PISCES
LACERTA
α
γ
β
M31
β
Mirach
M33
IC 1396
Hamal
Mothallah
α
α
1
NGC 752
CASSIOPEIA
β
α
Caph
α
Schedar
β
Almach
γ
TRIANGULUM
γ
2
γ
4
φ
NGC 457
NGC 891
ARIES
β
Ruchbah
M34
NGC 869
CEPHEUS
Algol
3
β
Segin
τ
Errai
NGC 884
γ
γ
α
Melotte 20
Mirphak
5
URSA MINOR
NGC 188
CAMELOPARDALIS
PERSEUS
NGC 1499
Polaris
α
M
S
E
S
N
W

queen who vainly boasted of her unrivalled beauty. There is real beauty here, though, with the aptly named Owl Cluster – although it is also sometimes referred to as the ET Cluster because its shape has been said to resemble the alien from the film of the same name. The brightest star visible in the cluster is one of the Owl's eyes, mag. +5.0 Phi (ϕ) Cassiopeiae. It lies 2° southwest of Ruchbah, so is quite easy to find. In truth, bright red Phi Cassiopeiae is not actually a member of the cluster at all, but a foreground star. All the same, it certainly adds to the view through binoculars or a small scope.

5. NGC 188

Also designated: C1
RA 0h 47m 11s, dec. 85° 14′ 38″

Once you tick off this next object you'll be halfway through the challenge. Located just 4° to the south of the Pole Star, Polaris, open cluster NGC 188 is often ignored by observers with equatorial mounts as locating objects this close to the pole can be a bit fiddly. But what's an observing challenge without a bit of challenge? Unusually for an open cluster, this one comprises many older stars, more yellow than the hot, white, young stars that you might have expected. With a magnitude of +8.1, it's not a naked-eye object, but a 4-inch telescope at 30x magnification will reveal it as a stretched scattering of stars set against a brighter circular core. ▶


Dark skies will help you track down the soft glow of NGC 188, or C1 in the Caldwell Catalogue

▲ The lonely Intergalactic Wanderer, C25, at 275,000 lightyears away is a challenge

Larger scopes will reveal arms gleaming with new star formation in C7, the spiral galaxy NGC 2403

Big aperture and transparent skies will get the best from the Flaming Star Nebula, C31

6. NGC 2403

Also designated: C7
RA 7h 36m 54s, dec. 65° 36′ 0″

We are halfway through, so now is a good time to take a break and warm up with a hot drink as you prepare for the second stint. Our first object in the final run is spiral galaxy NGC 2403 in Camelopardalis. It has an appearance very similar to that of the Triangulum Galaxy, with numerous HII star-forming regions within its two layers of spiral arms. Shining at mag. +8.9, this is one of the brightest galaxies in the sky – but again, like the Triangulum Galaxy it is large and that brightness is spread out. NGC 2403 is somewhat isolated in sparsely populated Camelopardalis. You can find it just under 8° west of mag. +3.3 Muscida (Omicron (ο) Ursae Majoris). A 4-inch telescope will show an elongated hazy patch, but you will need a 12-inch telescope to view the spiral arms.

7. The Intergalactic Wanderer

Also designated: C25, NGC 2419
RA 7h 38m 6s, dec. 38° 53′ 0″

A quick hop southwards into Lynx will take us to a distant globular cluster known as the Intergalactic Wanderer, as it was originally believed to be located outside the gravitational influence of the Milky Way (something we now know to be untrue). Discovered by William Herschel in December 1788, this cluster is one the remotest globulars ever found, at a distance of around 275,000 lightyears. Look for it 7° to the north of mag. +1.6 Castor (Alpha (α) Geminorum). It's a difficult object in a 4-inch telescope, but a 10-inch or larger will reveal its condensed core and patchy halo.

8. NGC 2392

Also designated: C39
RA 7h 29m 12s, dec. 20° 55′ 0″

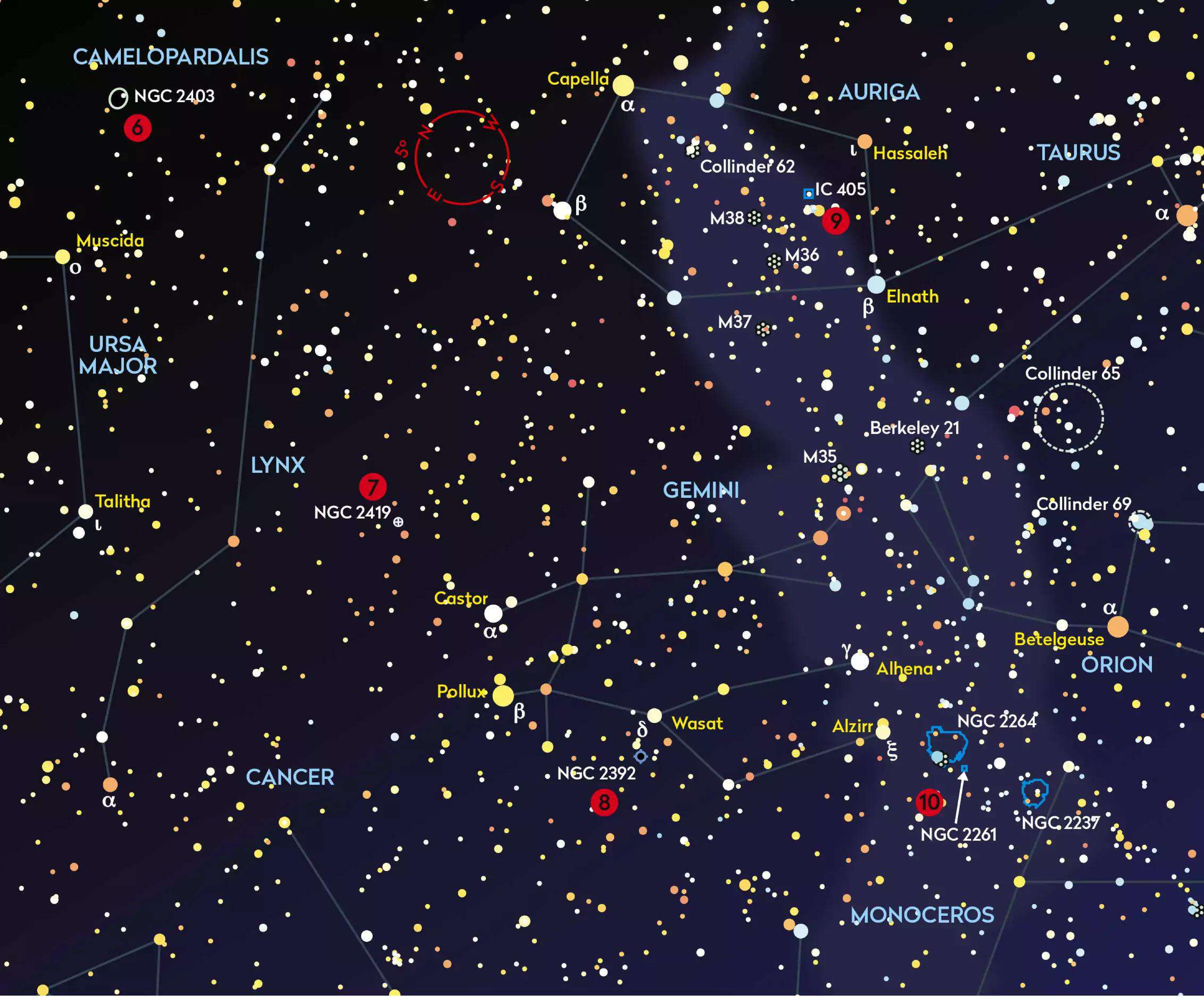
We continue our journey south into Gemini, sweeping past Castor and onwards to a point 2.4° southeast of mag. +3.5 Wasat (Delta (δ) Geminorum) to find a fascinating planetary nebula, NGC 2392. Although visible through a 4-inch telescope, with a diameter of only 48 arcseconds you'll need at least a 6-inch telescope to show the true shape of the nebula. A 10-inch or larger instrument will reveal a host of other delicate details, including two distinct shells – a bright inner mottled region with an outer faint halo, separated by a dark ring. The nebula's very distinctive appearance wasn't lost on William Herschel, who described it as "a very remarkable phenomenon" when he discovered it in 1787.

9. The Flaming Star Nebula

Also designated: C31, IC 405
RA 5h 16m 12s, dec. 34° 16′ 0″

Although our next object is an astrophotographer's dream, it is more challenging for observers. The Flaming Star Nebula lies 4.2° east-northeast of mag. +2.7 Hassaleh (Iota (ι) Aurigae) and is a delightful mix of both reflection and

BERNHARD HUBL/CCDGUIDE.COM X2, FRANZ KLAUSER/CCDGUIDE.COM, WOLFGANG PROMPER/CCDGUIDE.COM, CHART BY PETE LAWRENCE


CAMELOPARDALIS
NGC 2403
6
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TAURUS
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IC 405
9
M38
M36
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Elnath
β
Muscida
ο
URSA MAJOR
M37
Collinder 65
Berkeley 21
M35
LYNX
7
NGC 2419
GEMINI
Talitha
ι
Collinder 69
Castor
α
α
Betelgeuse
ORION
γ
Alhena
Pollux
β
δ
Wasat
Alzirr
ξ
NGC 2264
CANCER
α
NGC 2392
8
10
NGC 2261
NGC 2237
MONOCEROS

emission nebulosity. The star responsible for generating all the energy is HD 34078, which can be clearly seen at the heart of the nebula. However, this star is here by chance: it's just passing through on its long journey away from a cataclysmic interaction with the Trapezium stars in the Orion Nebula in the distant past. The roughly triangular shape of the nebula can be discerned through a 6-inch or larger telescope, but HD 34078 dominates the view. Try fitting a hydrogen-beta filter to your scope to tame the star.

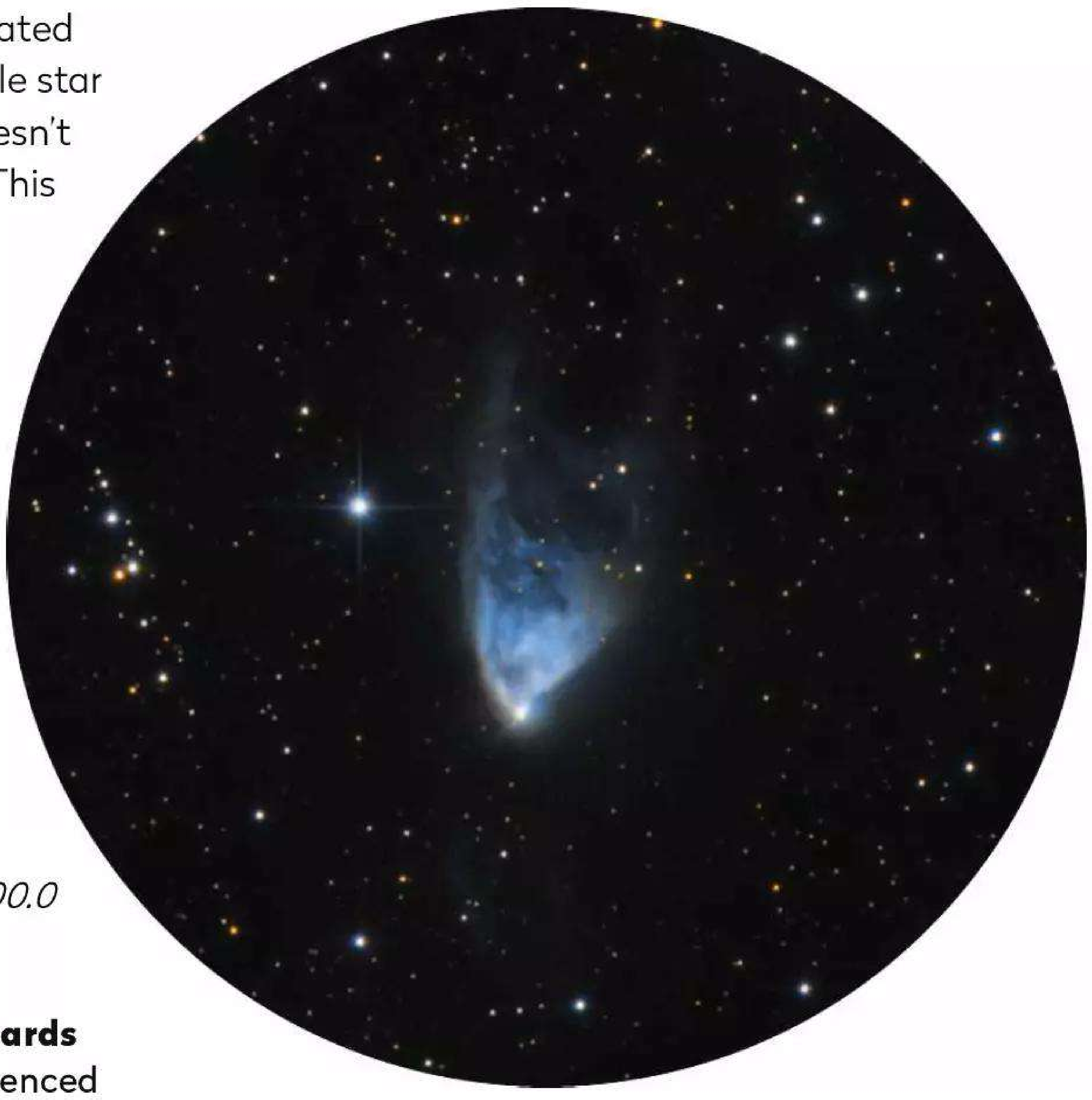
10. Hubble's Variable Nebula

Also designated: C46, NGC 2261
RA 6h 39m 12s, dec. 8° 44' 0"

Congratulations, you have reached the final object! This is the enigmatic comet-shaped nebula NGC 2261, also known as Hubble's Variable Nebula from a series of images captured by Edwin Hubble in January 1949. The nebula changes in brightness and to a lesser extent shape, and although it is illuminated at its head by the T Tauri variable star R Monocerotis, its variability doesn't exactly match that of the star. This unusual behaviour is caused by dust clouds orbiting close to the star, blocking its light and casting shadows across the nebula. Located 4.4° south-southwest of mag. +3.3 Alzirr (Xi (ξ) Geminorum), it is visible in a 4-inch telescope, though the nebula's curved wedge shape is more clearly revealed through an 8-inch telescope at around 120x magnification.

RA/dec. positions correct for J2000.0

Steve Richards is an experienced astronomer and astrophotographer



▲ Your final challenge is to locate the curious triangular-shaped nebulosity of Hubble's Variable Nebula, C46

Masuyama
MOP-
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MOP-7.5mm
Japan
53°
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Masuyama
MOP-5mm
53°
Japan

BBC
Sky at Night
MAGAZINE

Equipment round-up

BEST OF 2024

Over the past 12 months, we tested 31 different items of astronomical equipment. Here are five of the finest to have passed through our labs.

ALL PHOTOS: @THESHED/PHOTOSTUDIO

ZWO Seestar S50 smart scope

An enjoyable budget all-in-one that almost does everything

The ZWO Seestar S50 is a compact smart telescope, with a 50mm apochromatic refractor and focal length of 250mm (f/5). It's the S50's low price that sets it apart.

The S50's lightweight, compact design lends itself well to portability. Fully charged it has a stated battery life of six hours, likely to be less under cold conditions or when the scope's internal dew heater is turned on.

Operated via a smartphone or tablet, the S50 needs the Seestar iOS or Android app installed. The app automatically selects the light-pollution filter for certain targets, but you can override it. Recent app updates include enhanced image stacking. Targets can be selected from the Seestar app's recommendations or via a planetarium-style interface.

Once selected, the S50 moves automatically to the target. Only a few positional tweaks are needed to centre the target, then 'Goto success' is displayed in the app to show it's ready to start taking pictures. Different exposure lengths are available, but 10 seconds is adequate. The S50 live-stacks each exposure, and has an internal dual-band (OIII and H-alpha) light-pollution filter for imaging emission nebulae.

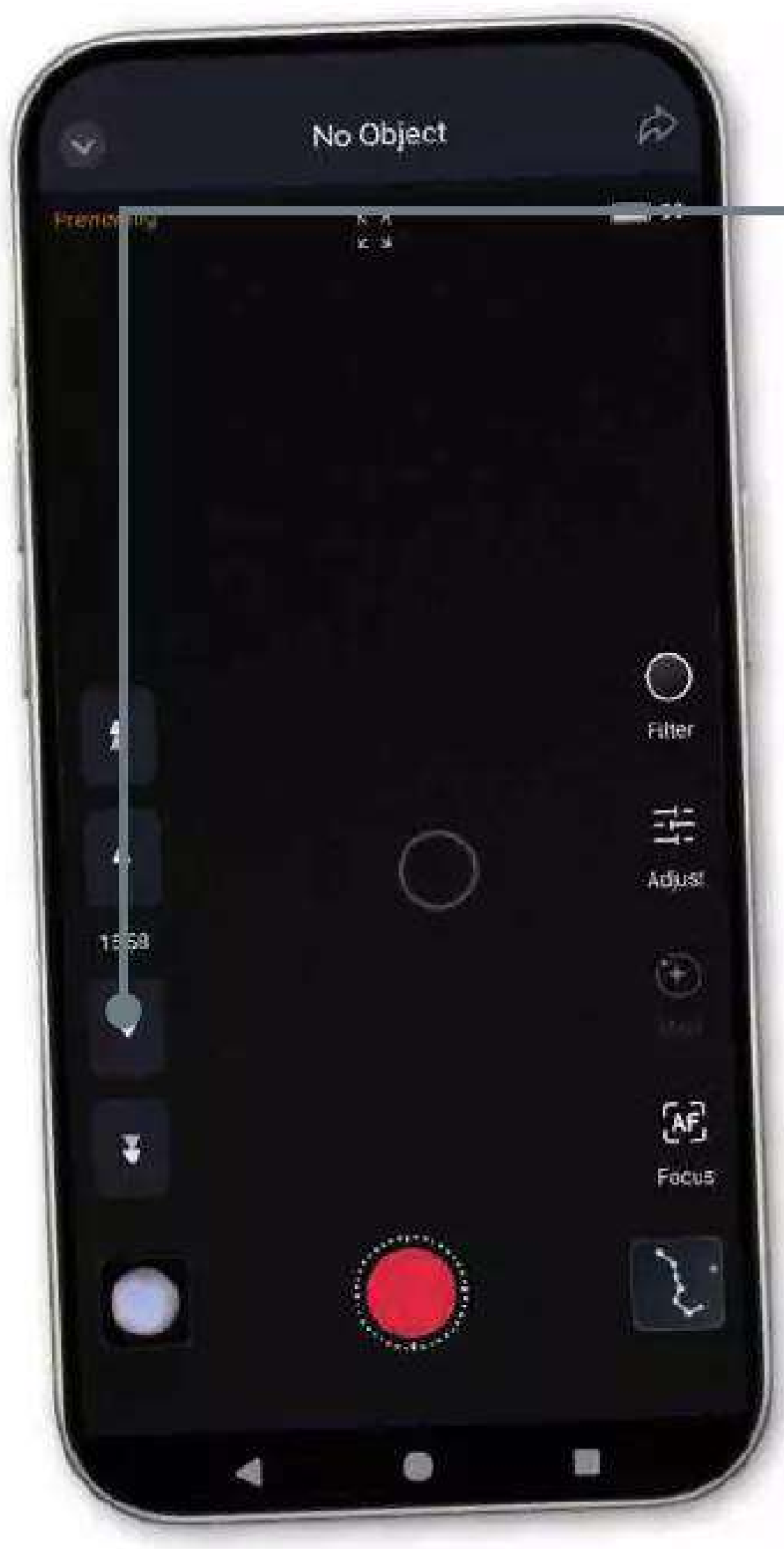
Some potential disadvantages: the unit's narrow field of view; portrait orientation of the sensor, meaning larger targets are sometimes truncated or less than optimally framed; and it is altaz-mounted but emulates equatorial motion via software and stepper motors, resulting in noisy corner regions of stacked images captured over long integration times. The S50's short focal length also doesn't allow detailed images of planets, rendering only a small, basic view of Jupiter and its two main belts. But it was good for overview shots of the Moon and Sun.

In summary, the Seestar S50 offers a fast set-up for beginners and professionals, enabling reasonable-quality imaging of deep-sky and larger Solar System objects at a good price. Even better, it's a lot of fun to use.

Vital statistics

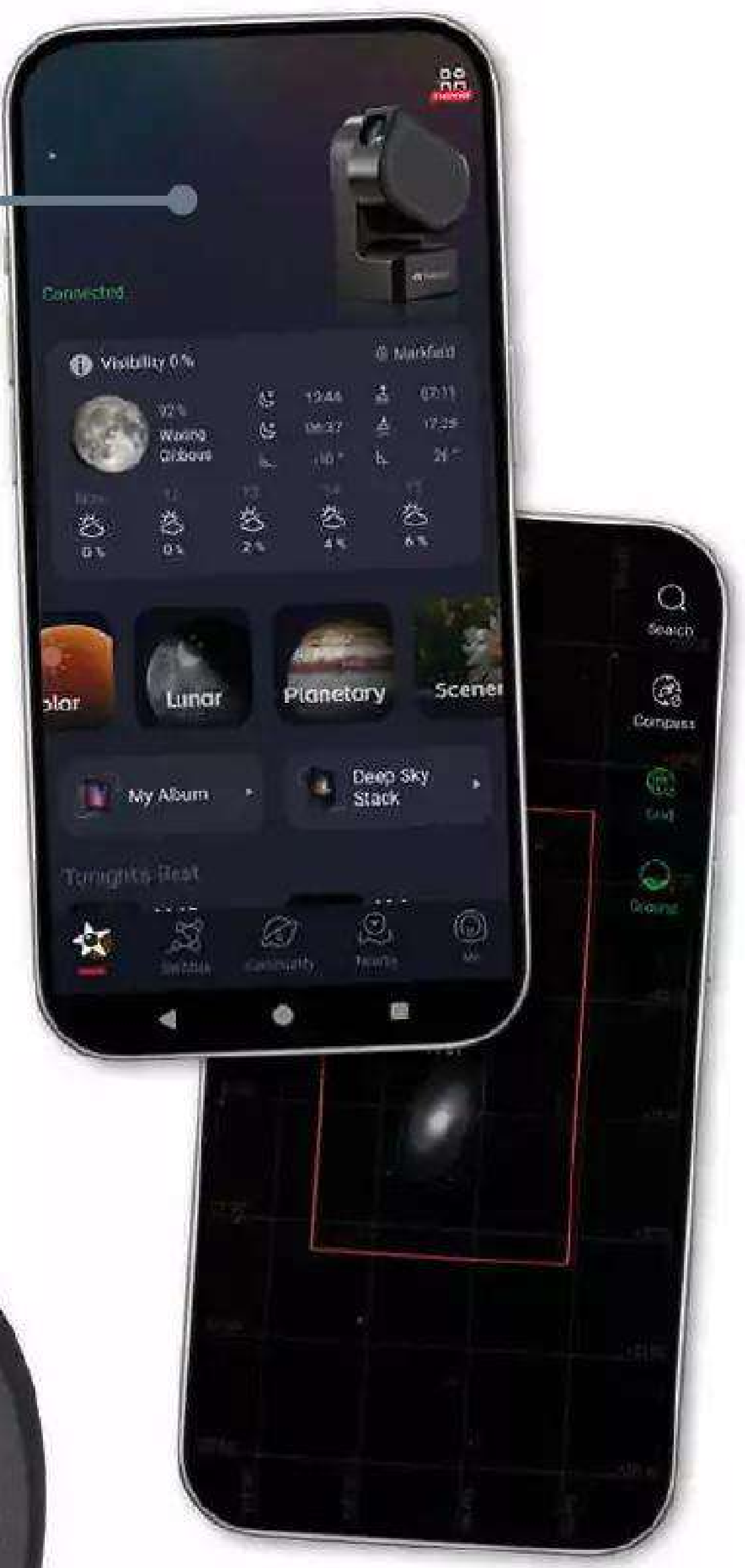
- **Price** £539
- **Optics** 50mm triplet apo refractor
- **Focal length** 250mm, f/5
- **Power** 6,000 mAh battery
- **Weight** 2.5kg
- www.365astronomy.com

Verdict ★★★★½



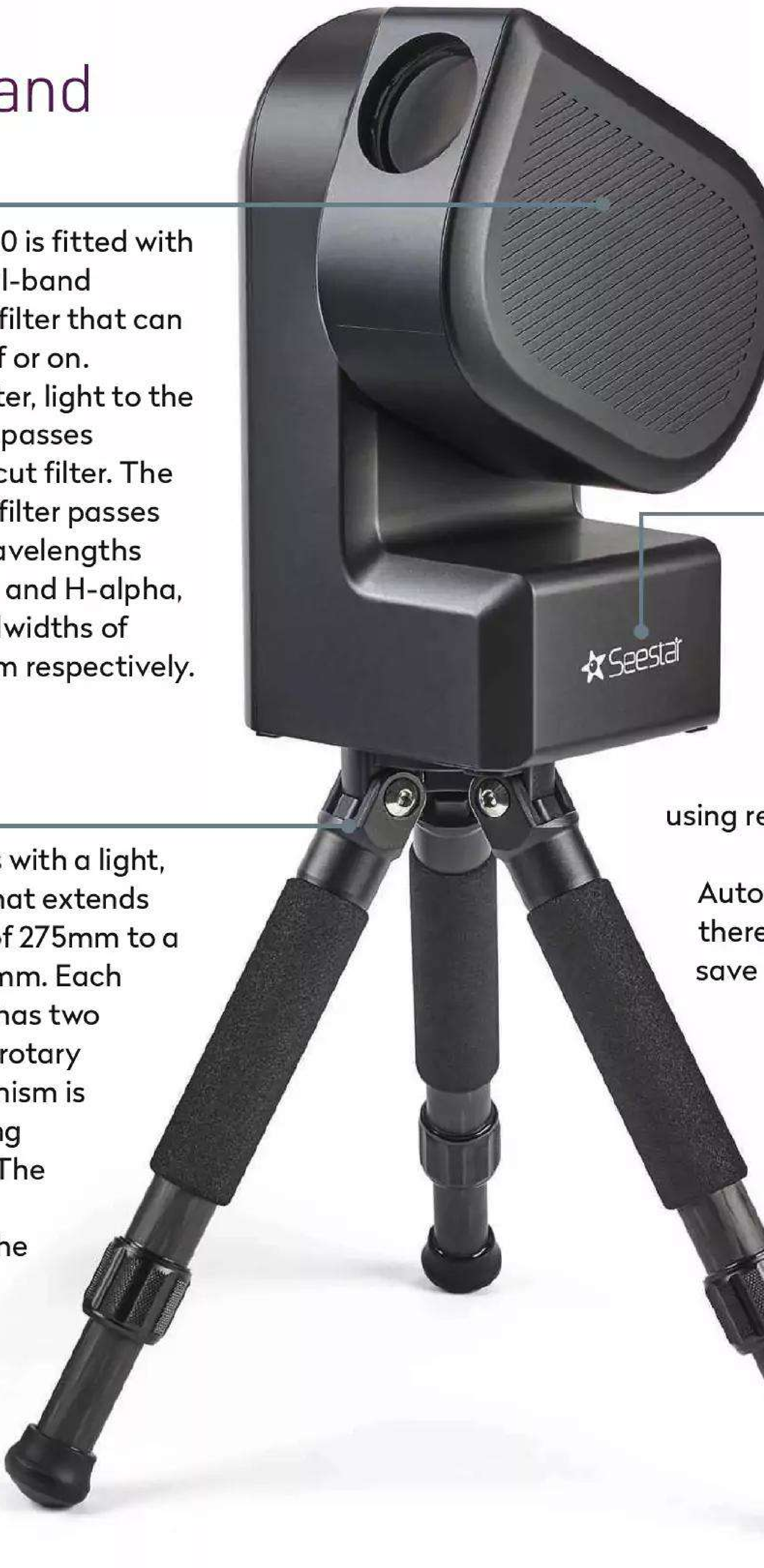
Electronic focusing

The S50 auto-focuses on its targets and does this well. There's an option to display focus adjustments on your device screen, which allows you to manually adjust and record the optimum setting if you feel you can do better. The ability to pinch-zoom a target on screen to magnify our adjustments is also useful.



Seestar control app

The straightforward app for iOS and Android includes a virtual sky atlas, S50 settings options, telescope modes, focus/auto-focus, positional tweaks and access to a user community. It also shows the battery level and acts as the view screen for your live-stacked images. Access to multi-session stacking options is also provided.



Dual-band filter

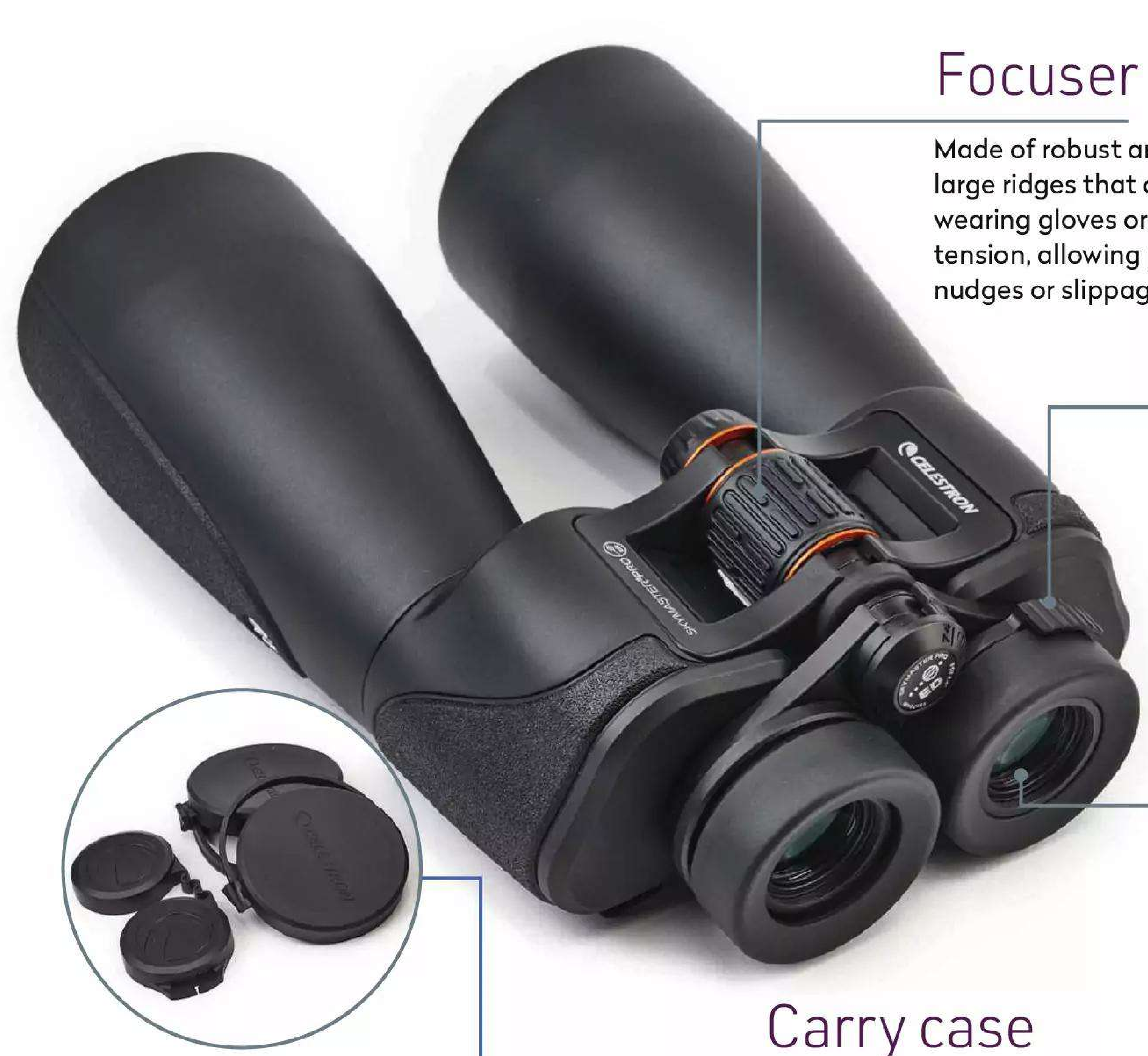
The Seestar S50 is fitted with an internal dual-band light-pollution filter that can be switched off or on. Without the filter, light to the IMX462 sensor passes through an IR-cut filter. The light-pollution filter passes narrowband wavelengths centred on OIII and H-alpha, with pass bandwidths of 30nm and 20nm respectively.

Tripod

The S50 comes with a light, sturdy tripod that extends from a height of 275mm to a maximum 363mm. Each adjustable leg has two sections and a rotary locking mechanism is used for levelling the telescope. The S50 unit is connected to the tripod via a 3/8-inch screw thread.

Internal storage

The S50 provides 64GB of internal storage. This is used to save raw videos of the Sun and Moon that can later be stacked using registration-stacking software such as AutoStakkert! Excitingly, there is also an option to save individual FITS files, which can then be extracted and processed using external programs.



Focuser

Made of robust and firm rubber, the centrally located focuser has large ridges that offer plenty of grip, allowing easy focus even if wearing gloves or with cold hands. It has just the right amount of tension, allowing precise movements without the risk of accidental nudges or slippage.

Diopter adjustment

The Skymaster Pro ED binoculars have a diopter on the right-hand eyepiece for fine-tuning focus. Thanks to the two large, ridged tabs, this was easy to locate with the binoculars raised to our eyes, and we found that the movement to adjust was firm yet smooth.

1.25-inch threaded eyepieces

Each eyepiece is threaded to enable 1.25-inch astronomical filters to be fitted. This allows the use of light-pollution filters if heading to brighter locations, or UHT filters for increased contrast while perusing nebulous regions. Of course, a filter is required for each eyepiece, so these must be purchased in pairs.

Lens caps

The front lenses are protected by secure individual rubber caps that attach to the binoculars with rubber bands. However, these can be easily removed if preferred while stargazing. The eyepieces are covered by rubber caps joined in the centre and have hoops that allow them to be connected to the carry strap.

Carry case

Supplied as standard is a sturdy nylon bag that holds the binoculars securely. The bag and the large strap enables the binoculars to be transported safely to dark-sky sites. On the rear of the bag is a pair of sturdy hoops for attaching it to a backpack if hiking.

Celestron SkyMaster Pro

ED 15x70 binoculars

This popular big-magnification pair gets even better with a lens upgrade

Celestron's popular SkyMaster 15x70s have been updated to include extra-low dispersion (ED) glass lenses. The binoculars are well made, with snug-fitting and robust caps. The main body is contoured, with grippy protective rubber coatings. The centrally located focus wheel had a firm, yet smooth action. The large 70mm-aperture lenses allow plenty of light gathering. For protection, the glass is recessed within the barrel by a few centimetres, while the internal barrel is ridged to reduce reflections.

Despite the 2.1kg weight, the binoculars are still comfortable and easy to hold steady. The twistable eye-cups allow up to 16mm of eye relief, meaning they can be enjoyed by astronomers with glasses. Adjusting the binoculars is easy, so that the distance between the exit pupils is correct for the eyes.

A 60%-illuminated Moon, high in the sky, was well placed for our first test. The lunar views we received were excellent, with sharp details highlighting the craters and no notable colour fringing. Nearby was the Beehive Cluster, M44, which not only fitted our field of view easily, but presented stunning views of the brighter stars, despite a bright Moon being in proximity. Stars were round and tight, with no distortions or aberrations visible.

The brighter stars within the constellation Cassiopeia further confirmed the excellent optical quality of the SkyMaster Pro EDs, which allowed the contrasting star colours to really stand out as we scanned the skies. This contrast was particularly noticeable while we observed the Double Cluster in Perseus. The clusters appeared to have been sprinkled across our view, with the fainter red stars presenting beautifully against their bluer counterparts.

Despite holding the binoculars without a tripod, we enjoyed exceptional views throughout the session, although for longer or more detailed observing we would recommend mounting them on a sturdy tripod. The Celestron SkyMaster Pro ED 15x70 binoculars excelled at every target we tried and would make a great addition to anyone's observing kit.

Vital statistics

- **Price** £319.99
- **Optics** ED glass, fully multicoated
- **Aperture** 70mm
- **Magnification** 15x
- **Weight** 2.1kg
- **Tel** 01603 486413
- www.wexphotovideo.com

Verdict ★★★★½

ALL PHOTOS: @THESHED/PHOTOSTUDIO

Askar V apo modular telescope kit

A refined refractor with swapable lenses that offers remarkable flexibility

This optical tube assembly (OTA) with interchangeable lenses offers both a 60mm ('V60') and an 80mm ('V80') triplet refractor option, plus the opportunity to change between these two focal lengths during a single imaging session. Having a field flattener, focal-length extender and reducer, for both the V60 and V80 components, means access to six focal lengths across the combinations. Alone the V60 plus reducer has a focal length of 270mm at a fast f/4.5, and with the extender attached this increases to 446mm. The 80mm with reducer has a focal length of 384mm, increasing to 600mm with the extender.

The build and quality of each element is flawless. The dust caps are all metal, while the lens caps screw rather than slide on. There is also a beautifully machined cover for the fine-focus adjustment knob, and even a dust blower for the lenses.

Changing between the lenses is simple – the V80 and V60 screw on to the main tube. The flattener, reducer and extender come with the correct spacing for both objectives annotated, requiring a simple twist to hit the correct marker.

Despite the wide field on the V60, stars appeared round from edge to edge. We slewed over to the Moon and resolved some pleasing details on the lunar surface. Popping our full-frame DSLR on, we took a few snaps to stack later.

Switching to the V80, the field was extremely flat. Swapping the extender for the flattener was easy. It was only when we paired the V80 with the reducer that we noted star bloating in the outer third of the image, although they stayed round.

Once we paired the V60 with the reducer we had more noticeable curvature; swapping for our crop sensor variant reduced this. After using the flattener, post-processing revealed no noticeable vignette, even for full-frame images. We preferred using the V60 or the V80 with the flattener added, as that's where the Askar V performed best. However, the provided reducer and extenders did offer a fantastic level of flexibility for the price point.

Overall, the Askar V is a great imaging refractor for all levels, at a good price.

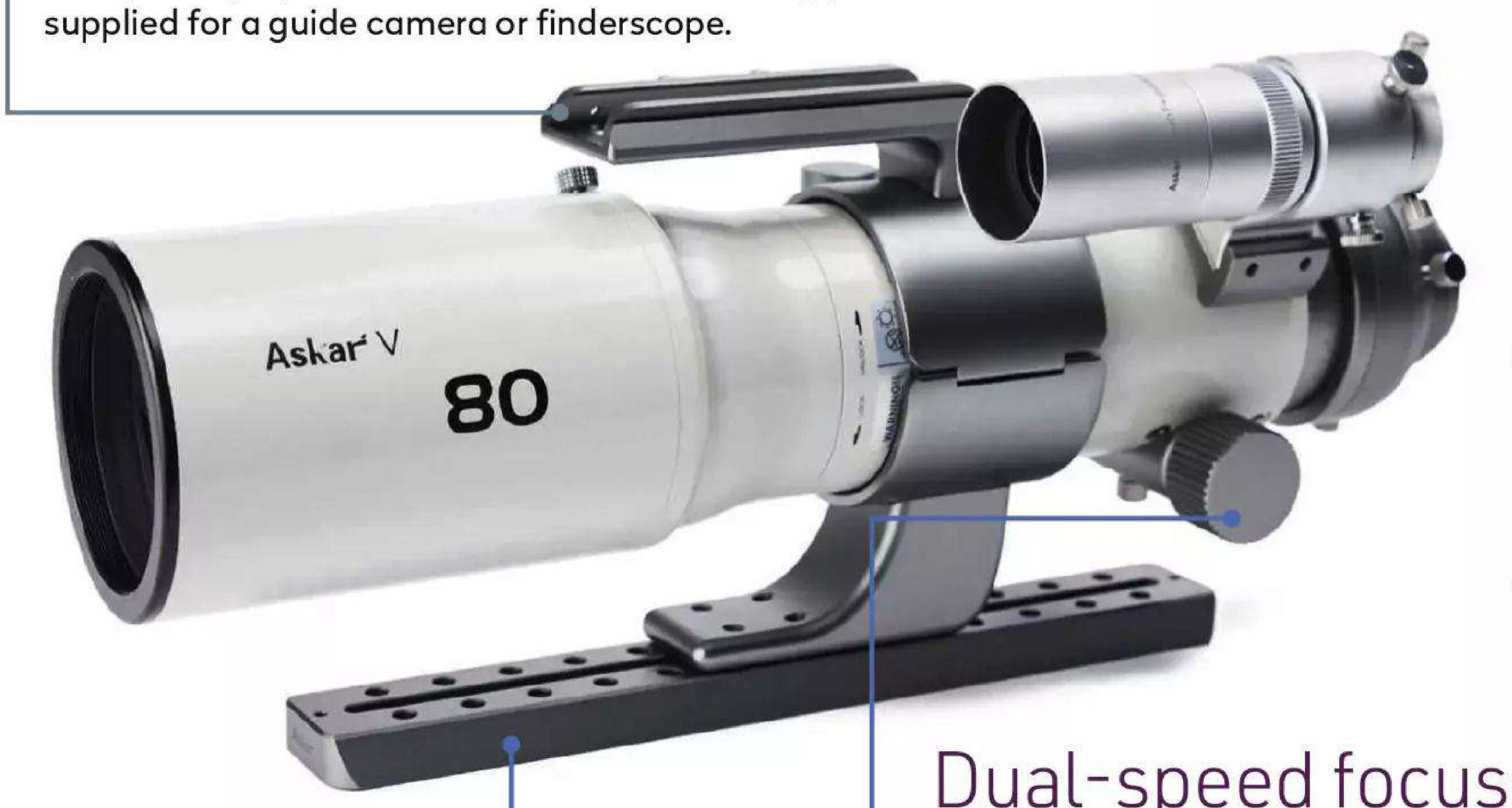
Vital statistics

- **Price** £1,798
- **Optics** Triplet apo refractor
- **Aperture** 60mm and 80mm
- **Focal length** 360mm or 500mm
- **Extras** Reducer, flattener and extender, tube rings and dovetail
- www.firstlightoptics.com

Verdict ★★★★½

Carry handle and mounting points

Attached to the tube ring is a handle for safe and secure carrying of the OTA. This doubles as a mounting point for a guidescope – an essential part of many astrophotographers' kit. An additional mounting point to the side of the OTA is supplied for a guide camera or finderscope.



Askar V FLATTENER
Askar V REDUCER
Askar V EXTENDER

Optical accessories

Separate flattener, reducer and extenders are provided with the Askar V as standard, with spacings provided for both objective lenses. This means six different focal lengths are available when the reducer or the extender is attached to either objective, while the flattener improves field curvature for each.

Tube ring and dovetail

The Askar V comes ready fitted with a wide, robust tube ring that is easy to unclamp from the OTA. A long dovetail bar is provided, which will fit standard equatorial mounts. However, this can also be unscrewed and the shorter foot used to give additional mounting options.

Dual-speed focuser

High-precision focusing is key to getting the most from our astrophotos and the Askar V's fine focus helps achieve this. Both focus knobs are beautifully machined and provide a firm but fluid movement with no slack. The integrated field rotator makes it easy to manage camera orientation.

Askar V
80
60
V REDUCER
V FLATTENER
V EXTENDER
V 60

Carry case

A padded carry case houses the main OTA plus all the standard accessories, making the Askar V easy to transport. Each element is securely housed. There is room for an electronic autofocuser (EAF), with a removeable foam section should you wish to add this accessory to your kit.

Filter screw threads

On the underside of every eyepiece is a screw thread for 1.25-inch filters, such as colour or high-contrast varieties. Such filters can be used to elevate an astronomy session by boosting contrasts and enhancing details, or reducing aberrations.

MOP-15mm 53° Japan

Lightweight design

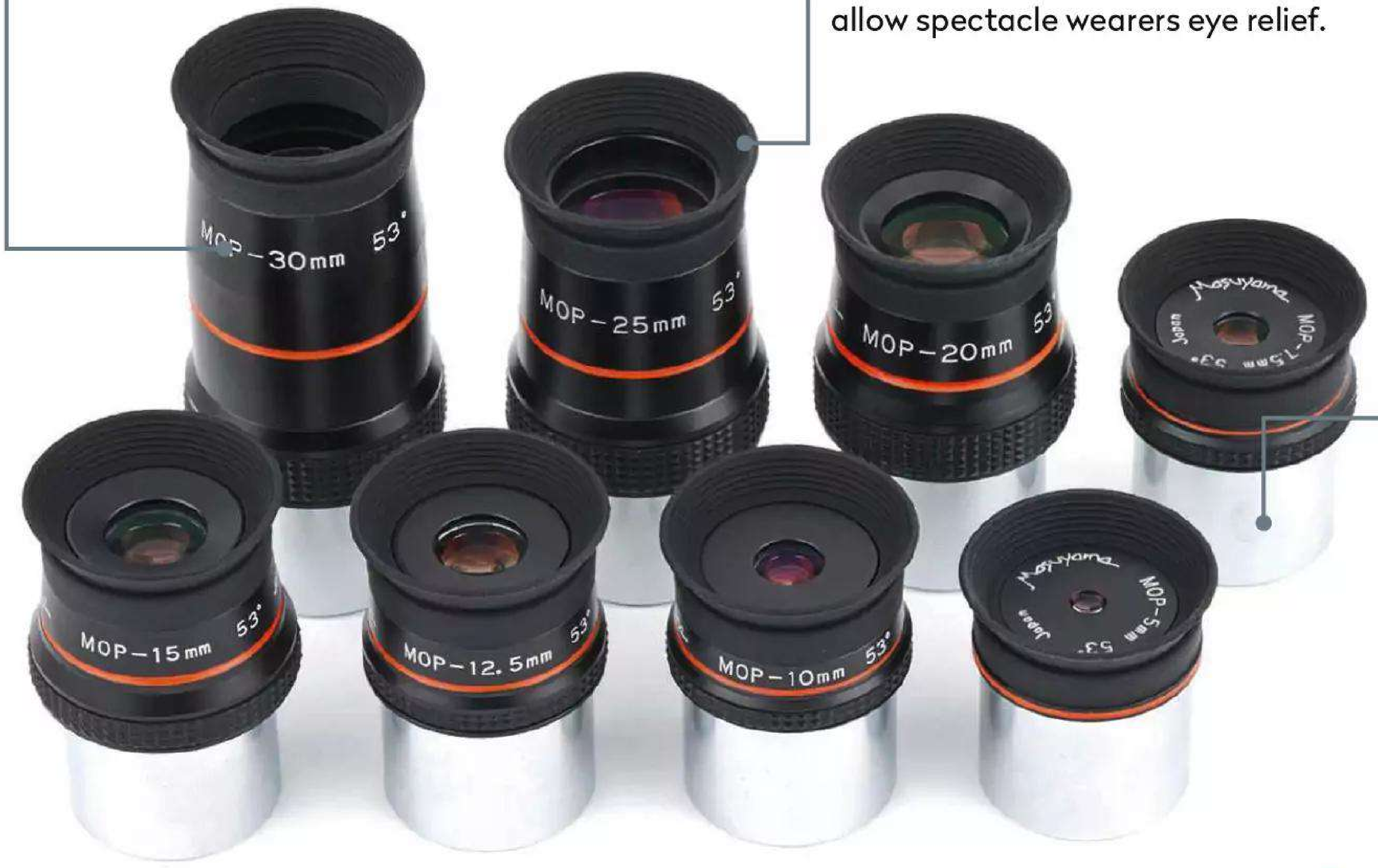
Well-designed eyepieces are not just great to look through, but easy to handle with gloved hands or in low light. With weights that range from only 60g to 140g across the set, the risk of dropping them is reduced. Each eyepiece has a ridge to show when it is slotted into the diagonal.

Rubber eye-cups

Each eyepiece comes fitted with a soft rubber eye-cup for maximum viewing comfort. These guide observers to the best resting position, providing an optimised viewing experience. Meanwhile, for the high-powered versions, the cups can be folded down to allow spectacle wearers eye relief.

Dust caps

Keeping eyepieces dust-free is essential to maintaining performance and ensuring you make the most of each observing session. These dust caps are a beautifully simple but effective addition, which allows you to easily swap eyepieces knowing that each one will be free of dust.



1.25-inch barrels

Each eyepiece has a 1.25-inch chrome-coated stainless-steel barrel that is familiar to all keen visual astronomers. The smooth design allows for easy transition into and out of a 1.25-inch diagonal, making these eyepieces easy to swap out in dark conditions, and ensuring they are secured.

Masuyama 1.25-inch 53° eyepieces

Eight high-end eyepieces that open up heavenly views – for a premium price tag

Masuyama's offering of 53° eyepieces covers a great range, from a long focal length 30mm down to a punchy 5mm.

With an apparent field of view of 53°, we were curious about field illumination and eye relief versus narrower variants. There isn't an option to purchase all eight eyepieces as a set. Instead, we received them within a single parcel, each individually packaged in smart boxes.

Armed with our 81mm refractor, we started with the lowest power, inserting the 30mm for star alignment. Popping over to Vega, we were greeted by a superb field of view that was well illuminated from edge to edge. Alignment completed, we slewed to Albireo with the 25mm, enjoying exquisite colour contrasts between the gold and blue stars. This was repeated at 20mm and 15mm, the optics proving flawless. Next, selecting the Orion Nebula, M42, the 12.5mm eyepiece provided a reasonable 36x magnification and we resolved some lovely detail among the mist surrounding the Trapezium. Eye relief continued to be excellent through the 12.5mm and 10mm sizes as we finally headed to the Double Cluster in Perseus. The field of view remained beautifully flat from edge to edge, with no distortions, allowing us to enjoy a pleasingly immersive view for 53°. As we stepped up the power, we were impressed to discover that the eyepieces appeared to be at least close to parfocal, barely requiring re-focus. Eye relief was less forgiving at 7.5mm, which could be challenging for glasses wearers.

Using a 1,100mm focal length, the 30mm, 25mm and 20mm eyepieces (providing 37x, 44x and 55x magnification) proved again to be excellent for star alignment. With the 15mm, the Masuyama 53° set really came into its own – the view exceptional and eye relief perfect. Even at 7.5mm, lunar details remained sharp even at 148x magnification. Next, we popped in the 5mm. With an aperture of 101mm, the theoretical limit of useful magnification for this focal length is about 200x, whereas the 5mm pushes to 220x, and we were pleased with the results.

Overall, these Masuyama eyepieces more than impressed us. Bearing in mind their cost, these are eyepieces to cherish, not relegate to a forgotten kitbag.

Vital statistics

- **Price** £185 each (for 5mm–20mm), £195 each (for 25mm and 30mm)
- **Lens design** Ortho Plössl
- **Optical elements** 5
- **Weight** 60g, 70g, 80g, 90g, 100g, 120g, 115g, 140g
- www.firstlightoptics.com

Verdict ★★★★½

ALL PHOTOS: @THESHED/PHOTOSTUDIO

Altair Astro Hypercam 585C colour camera

From nebulae to the Moon, this jack-of-all-trades does it all for under £500

The 585C may well be the answer to a question many astronomers ask: "What single camera can photograph nebulae, galaxies, planets and the Moon?".

While the ideal telescope for deep-sky viewing would be a short-focal-length refractor, time and weather constraints meant we opted for a larger refractor to which we could add a Barlow for lunar and planetary imaging, while accepting the compromise on image scale for the deep-sky images.

Even with the lowest gain setting, the Hypercam 585C was really responsive, so we took half an hour's worth of 30-second exposures to retain detail around the Trapezium area in the Orion Nebula. The resulting stacked image had lots of detail in the faint areas. The next target was M82, the Cigar Galaxy. For this dimmer target we chose three-minute exposures. Once again, the detail in the dusty lanes and red hydrogen jet areas of the galaxy were impressive.

Next, short, fast exposures, using the Moon and Jupiter as the targets. By selecting a smaller region of interest than the full 3,840 x 2,160 pixels available, we found the Hypercam 585C was bringing home over 65 frames per second (fps), capturing Jupiter's moon Io just grazing the edge of the planet's disc in a very short time. With a one-shot-colour camera like the 585C, all the data is gathered at once; no need for separate RGB filters. This is an easy camera to use.

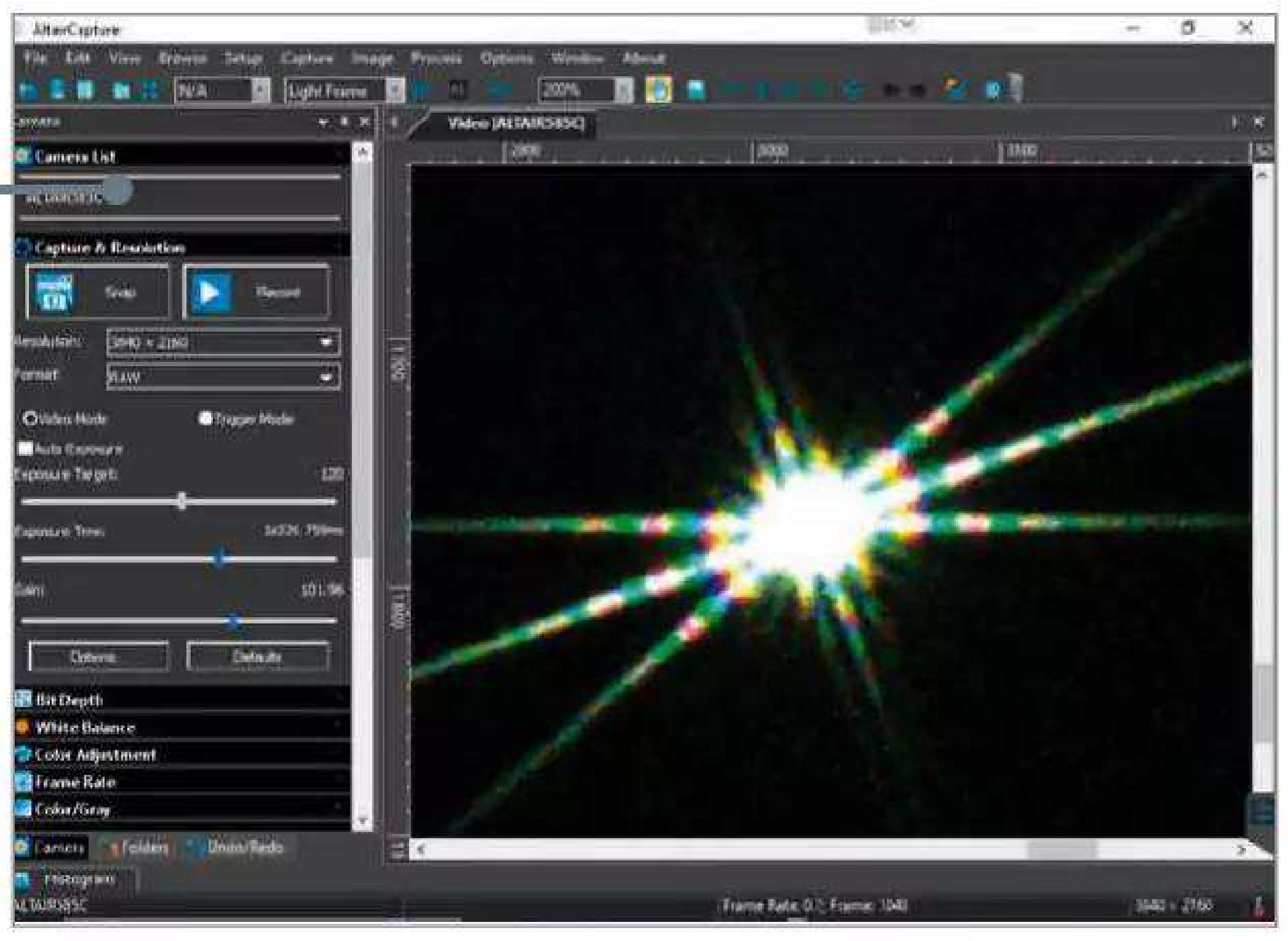
For our lunar image, we chose an interesting quarter of the Moon, with nicely lit craters and good variance between the lightest and darkest areas, using the whole of the CMOS chip for the capture. Our mid-range laptop was averaging 22fps in full-resolution 16-bit mode. The quick response of the Hypercam 585C enabled us to take thousands of frames and skim off the blurry ones, leaving a sharp, high-contrast image with good resolution.

In an ideal world, we would have a different telescope and camera combination to match each target. But, in the real world, the well priced Hypercam 585C offers great results from deep-sky to Solar System objects.

Vital statistics

- **Price** £359
- **Sensor** IMX585 STARVIS 2 BSI
- **Resolution** 8.3MP, 3,840 x 2,160 pixels
- **Exposure range** 0.1ms–1,000 seconds
- **Size** 80mm x 65mm
- **Weight** 295g
- www.altairastro.com

Verdict ★★★★★


AltairCapture
File Edit View Browse Setup Capture Image Process Options Window About
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Light Frame
200%
Video [ALTAIR585C]
Camera List
Capture & Resolution
Snap
Record
Resolution: 3840 × 2160
Format: RAW
Video Mode
Trigger Mode
Auto Exposure
Exposure Target: 120
Exposure Time:
Gain:
Options
Defaults
Bit Depth
White Balance
Color Adjustment
Frame Rate
Color/Gray
Camera
Folders
Undo/Redo
Histogram
ALTAIR585C
3840 × 2160

Software

Each Hypercam comes with a 12-month license for the excellent SharpCap Pro, the capture software of choice for many. Altair also provides its own application, AltairCapture, which we used to great effect. Its simple interface makes it easy to operate even in the early hours when tiredness sets in.

ALTAIR™
HYPERCAM

512MB DDR memory

Fast frame rates and data transfer are facilitated by the 512MB DDR onboard buffer memory, which ensures there are no bottlenecks when capturing large amounts of frames and writing the data to your PC, while the good-quality 1.5m USB 3.0 cable transfers the image information without introducing loss or unwanted noise.

USB-powered fan

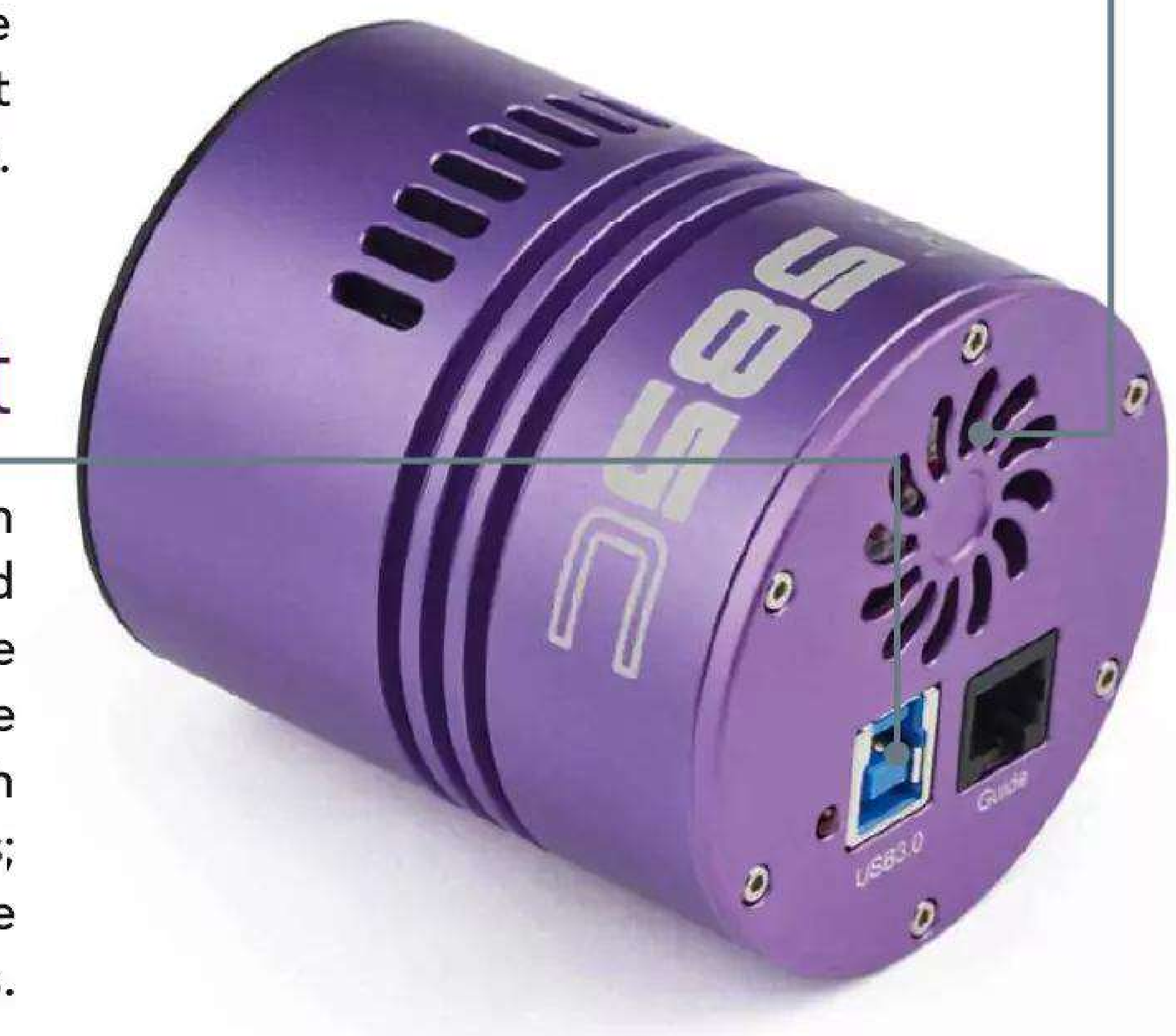
CMOS sensors get warm during use and the thermal energy can introduce noise to your images. A USB-powered fan pulls cooler air over a heat sink and out through a vent, to remove as much heat as possible without requiring a full-on thermo-electric cooling set-up.

Light, compact design

The 585C has the now-familiar barrel design in Altair's trademark purple livery. It is just 80mm long and 65mm in diameter, weighing in at a pocket-sized 295g. Fitting neatly in the hand and requiring only a USB cable and perhaps a nosepiece, it is a portable, lightweight and practical camera.

ST4 guide port

The rear of the camera has an ST4 port, and a cable is included for auto-guiding purposes. The Hypercam 585C is sensitive enough to be a guide camera. It's compatible with mounts from the major manufacturers; this could negate the need for separate guiding and Solar System cameras.


585C
USB3.0
Guide

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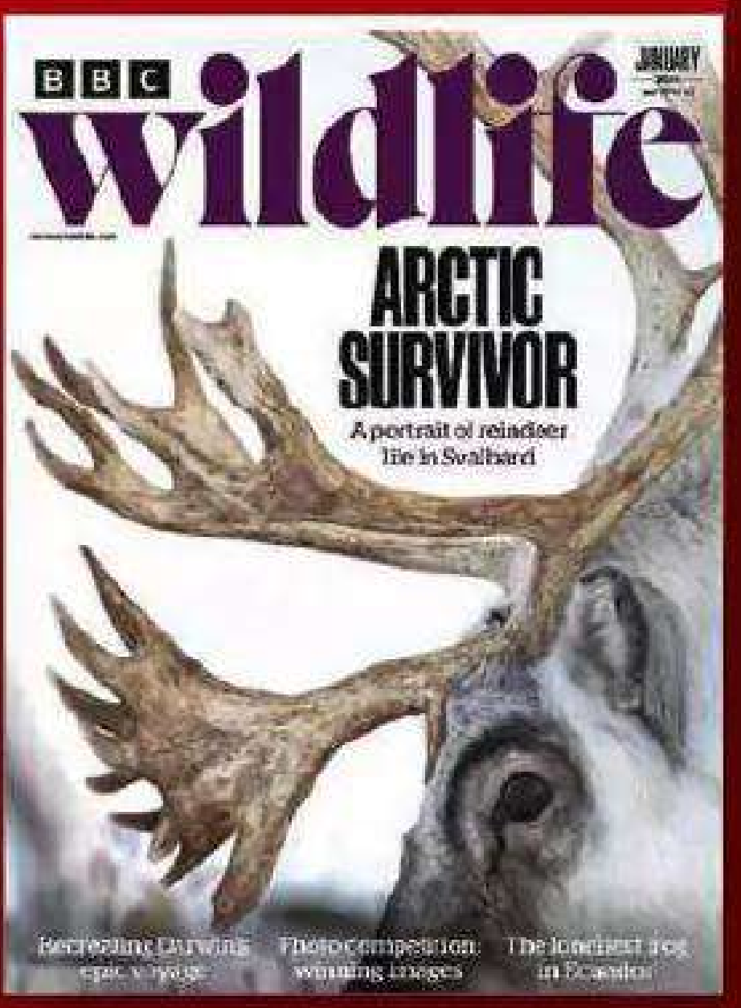
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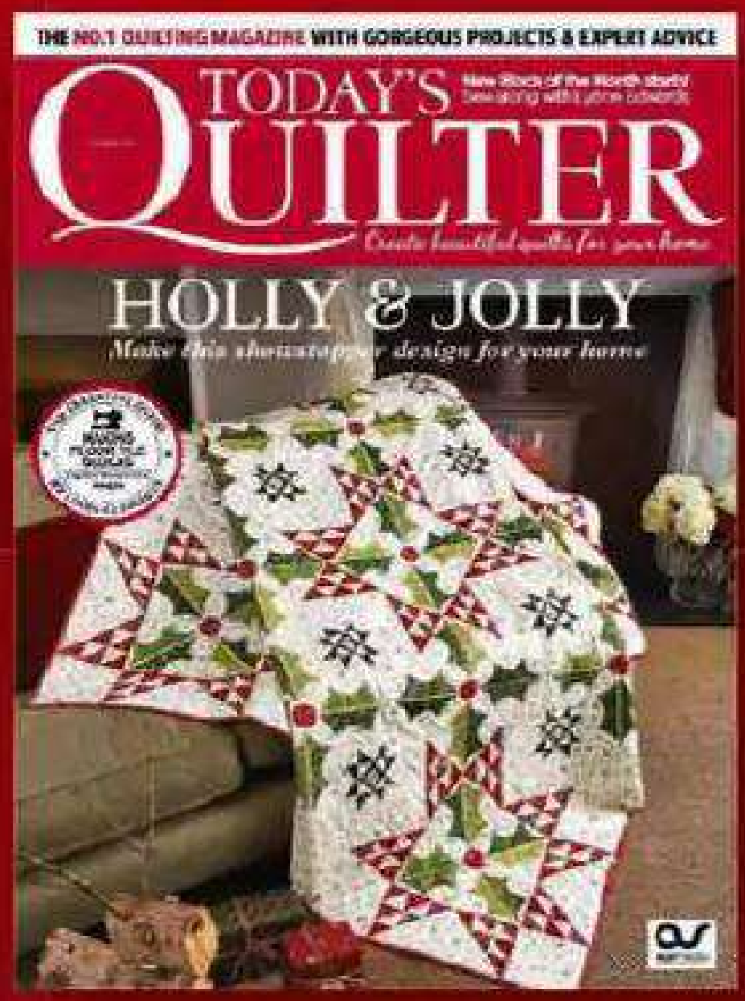
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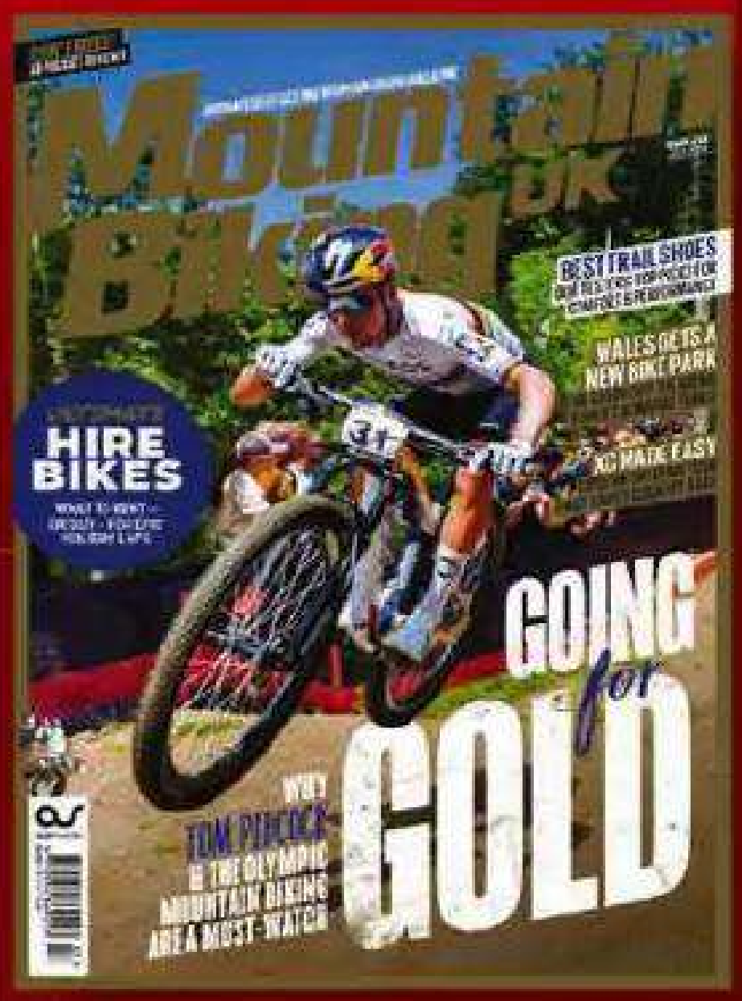
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DISCOVER

More great night sky events in *BBC Sky at Night Magazine's* Sky Guide each month

The night sky month by month 2025

Astronomy expert **Pete Lawrence** presents *The Sky at Night* on BBC Four and writes *BBC Sky at Night Magazine's* monthly Sky Guide

Your guide to the stars throughout the year

by **Pete Lawrence**

38 January
Quadrantid meteor shower peak

42 February
A spectacular month for planets

48 March
A solar and lunar eclipse

52 April
The Moon occults the Pleiades

56 May
Unusual shadow transit of Titan

62 June
Noctilucent cloud displays

66 July
Close pass of Saturn and Neptune

70 August
The planets put on a show

76 September
A busy month for the Moon

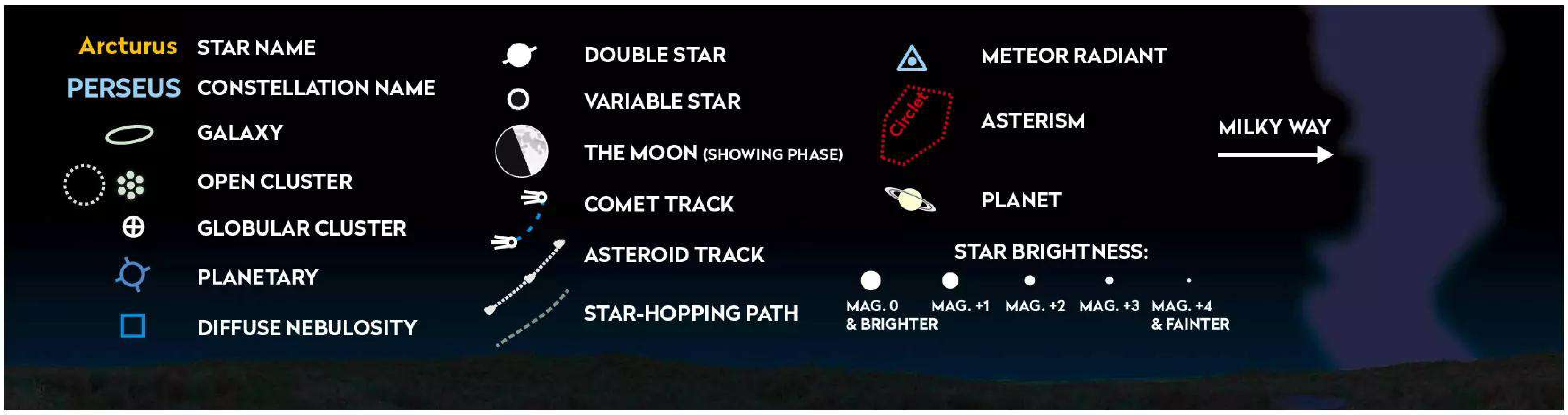
80 October
Catch the Harvest supermoon

84 November
A comet crosses the Beehive

90 December
Two moonless meteor showers

Key to monthly star charts

Use this key to get the most out of each month's detailed star chart



Arcturus
STAR NAME
PERSEUS
CONSTELLATION NAME
GALAXY
OPEN CLUSTER
GLOBULAR CLUSTER
PLANETARY
DIFFUSE NEBULOSITY
DOUBLE STAR
VARIABLE STAR
THE MOON (SHOWING PHASE)
COMET TRACK
ASTEROID TRACK
STAR-HOPPING PATH
METEOR RADIANT
Circlet
ASTERISM
PLANET
STAR BRIGHTNESS:
MAG. 0 & BRIGHTER
MAG. +1
MAG. +2
MAG. +3
MAG. +4 & FAINTER
MILKY WAY

January

Don't miss the peak of the Quadrantid meteor shower

3/4 January Quadrantid meteor shower peak

4 January Evening lunar occultation of Saturn

10 January Venus at greatest eastern elongation (47.2° from the Sun; evening)

16 January Mars reaches opposition

18 January Venus 2.2° north of Saturn (evening)

The Milky Way ▷

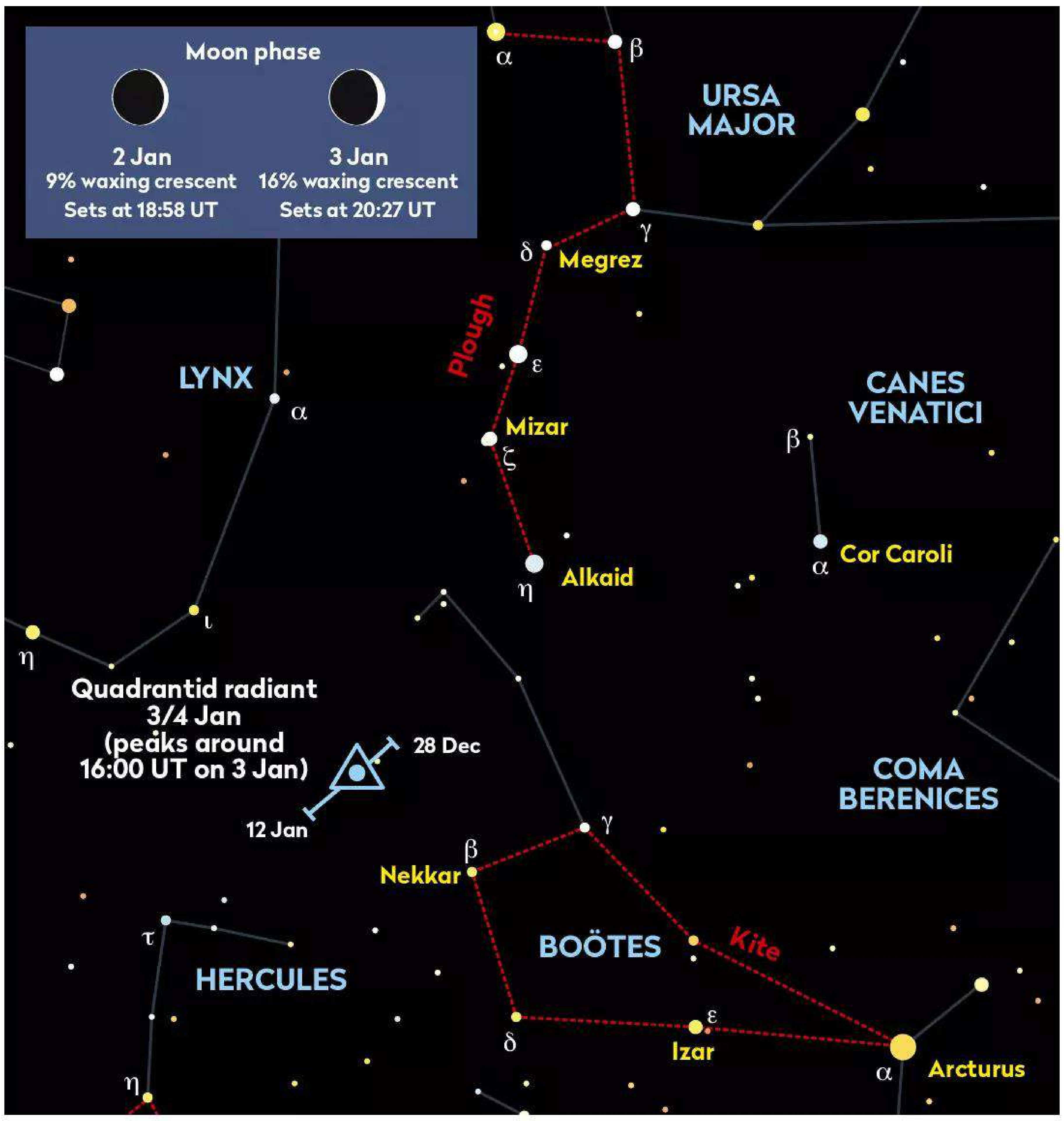
Tomás Andonie, Frutillar, Chile, 24 July 2023

January at a glance

At the start of 2025, the planets are well-placed. Brilliant **Venus** is a beacon in the evening sky after sunset, reaching greatest eastern elongation on 10 Jan when it will be separated from the Sun by 47.2°.

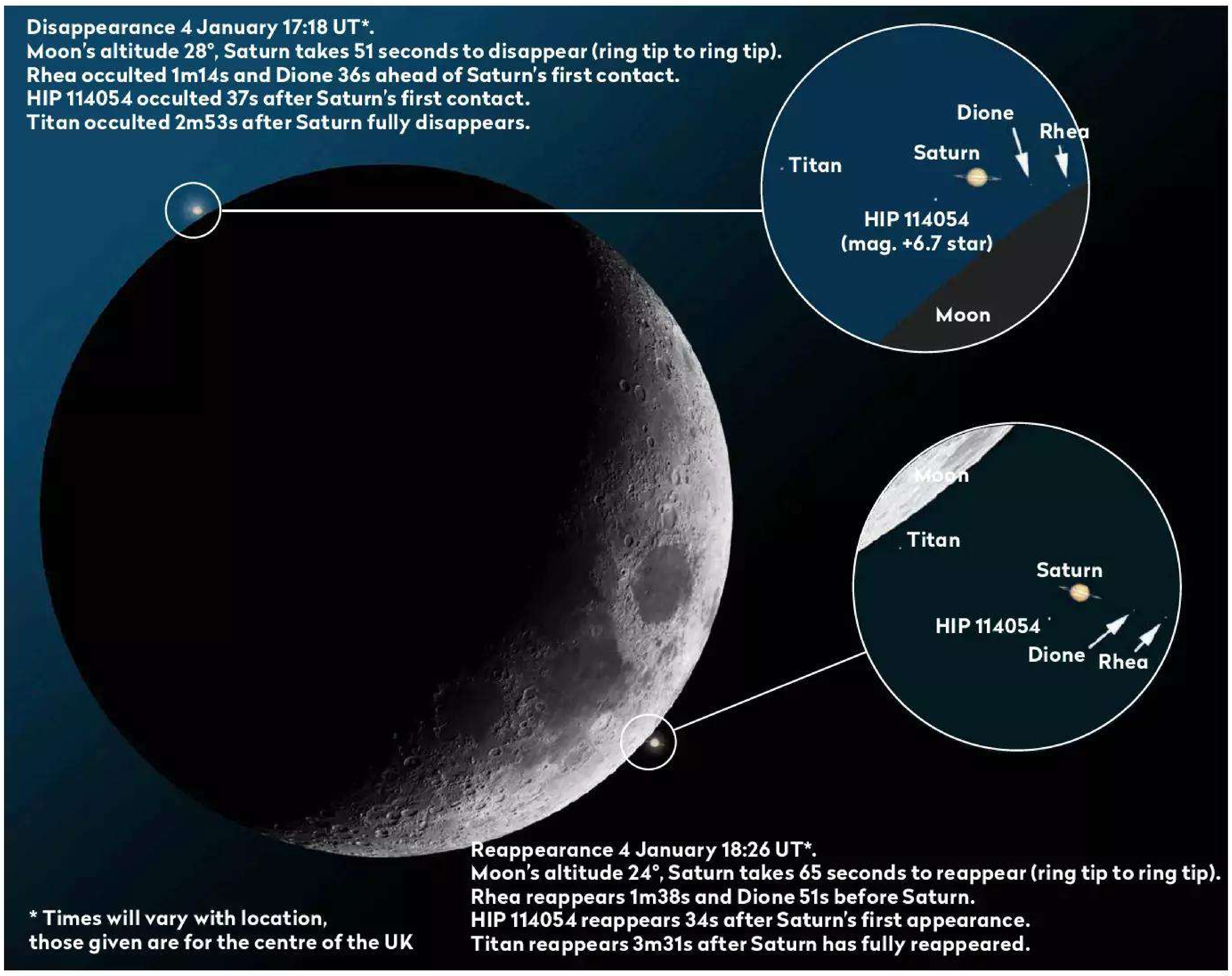
Following from the east is bright **Jupiter**, against the spectacular backdrop of the constellation Taurus, the Bull. If you can view Jupiter through a telescope, don't miss the **Ganymede shadow transits** that occur on the evenings of 13 Jan (18:30-21:00 UT), 20 Jan (Ganymede transit 18:33-20:58 UT, Ganymede shadow transit 22:31-01:00 UT) and 27 Jan (Ganymede transit 22:08-00:34 UT, Ganymede shadow transit 02:31 UT until Jupiter sets around 04:40 UT). Also, keep an eye out for **Callisto**, passing close to Jupiter's polar regions on the early evening of 14 Jan (17:22 UT) and early hours of 23 Jan (02:42 UT). Saturn's largest moon **Titan**, will also be casting its shadow on its host planet on 7 Jan (16:26-21:30 UT) and 23 Jan (15:30-20:58 UT).

Mars is located further east of Jupiter. It currently appears to move in a retrograde (east-west) fashion, from Cancer into Gemini throughout the month, reaching opposition on 16 Jan, when its position has it in line with Castor (Alpha (α) Geminorum) and Pollux (Beta (β) Geminorum), outshining both stars at mag. -1.4. Mars reaches opposition every 2.1 years, perihelic oppositions placing the planet near to Earth, aphelic ones further away. This opposition is aphelic, Mars displaying a 14-arcsecond apparent diameter in 2025, some way off the 25 arcseconds it achieves at a perihelic opposition. Despite this, it will be able to reach over 60° altitude from the UK.


Moon phase
2 Jan
9% waxing crescent
Sets at 18:58 UT
3 Jan
16% waxing crescent
Sets at 20:27 UT
URSA MAJOR
α
β
γ
δ
Megrez
Plough
ε
Mizar
ζ
Alkaid
η
LYNX
α
ι
η
CANES VENATICI
β
Cor Caroli
α
Quadrantid radiant
3/4 Jan
(peaks around
16:00 UT on 3 Jan)
28 Dec
12 Jan
COMA BERENICES
γ
β
Nekkar
BOÖTES
Kite
ε
Izar
δ
α
Arcturus
τ
HERCULES
η

▲ The Quadrantid meteor shower peak ZHR is 120 meteors per hour

The annual **Quadrantid meteor shower** reaches its peak on 3 Jan around 16:00 UT. The Moon won't interfere; a 15%-lit waxing crescent setting around 20:30 UT and located very close to Venus. The following evening, the **Moon** steals the limelight back as it occults Saturn, hiding the planet between 17:18 UT and 18:26 UT (observe from 20 minutes earlier than stated times). The Moon also makes a very close pass of Mars in the early hours of 14 Jan, the Red Planet just 11-arcminutes from the Moon's northern limb at 04:25 UT.


Disappearance 4 January 17:18 UT*.
Moon's altitude 28°, Saturn takes 51 seconds to disappear (ring tip to ring tip).
Rhea occulted 1m14s and Dione 36s ahead of Saturn's first contact.
HIP 114054 occulted 37s after Saturn's first contact.
Titan occulted 2m53s after Saturn fully disappears.

Reappearance 4 January 18:26 UT*.
Moon's altitude 24°, Saturn takes 65 seconds to reappear (ring tip to ring tip).
Rhea reappears 1m38s and Dione 51s before Saturn.
HIP 114054 reappears 34s after Saturn's first appearance.
Titan reappears 3m31s after Saturn has fully reappeared.

*** Times will vary with location,**
those given are for the centre of the UK

Dione
Rhea
Titan
Saturn
HIP 114054
(mag. +6.7 star)
Moon
Moon
Titan
Saturn
HIP 114054
Dione
Rhea

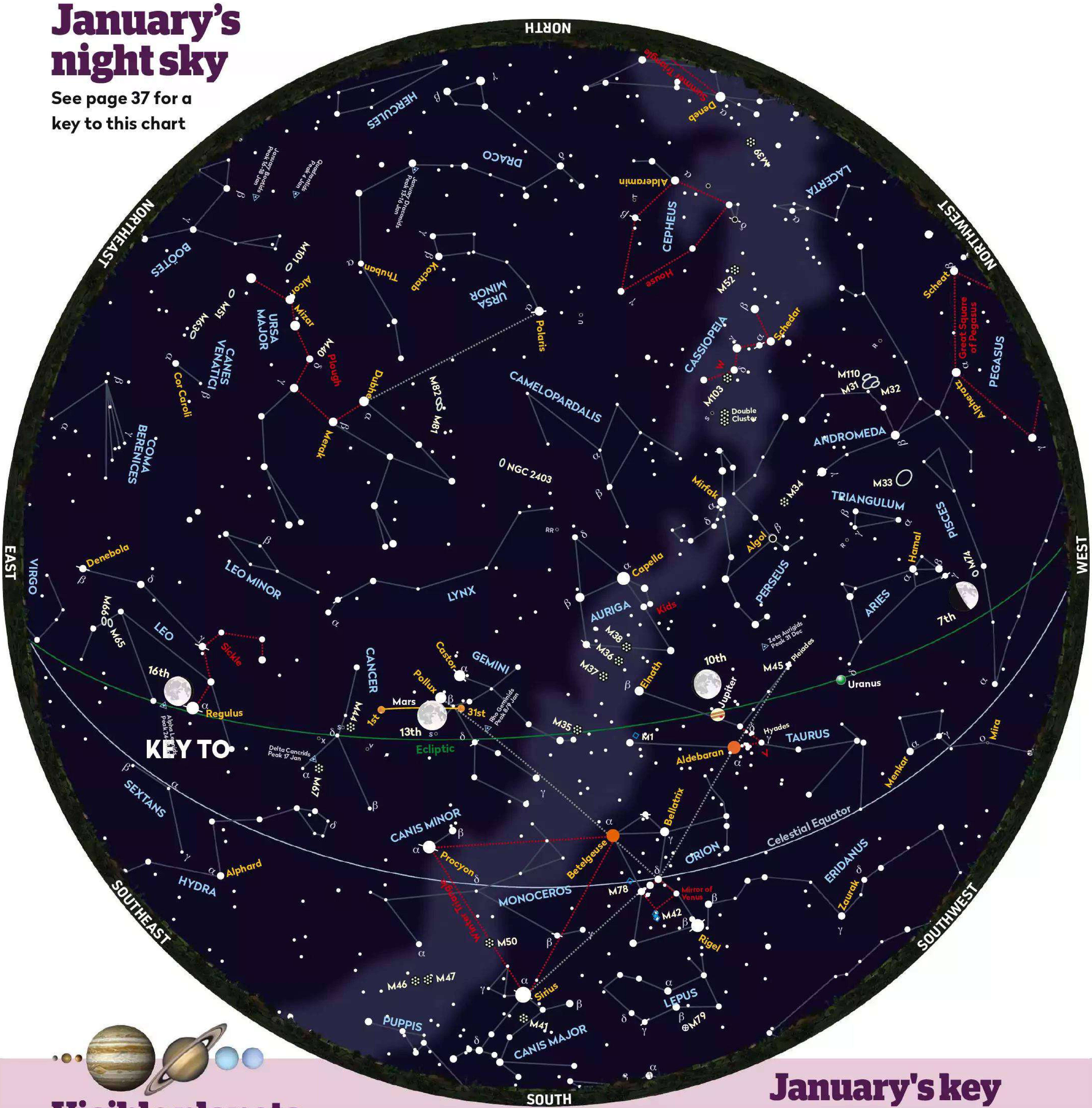
▲ Saturn is occulted by the Moon, early evening on 4 Jan, along with the mag. +6.7 star HIP 114054

These events all take place against the beautiful stars and constellations of winter, dominated by **Orion, the Hunter**. Visible as soon as darkness falls, Orion is useful as a navigational guide. Follow belt line southeast (down and left from the UK) and you'll arrive at the brightest night time star, **Sirius** (Alpha (α) Canis Majoris) in Canis Major, the Great Dog. Follow the belt line northwest and you'll arrive at **Aldebaran** (Alpha (α) Tauri).

PETE LAWRENCE X 3, ISTOCK X 7, NASA X 4

January's night sky

See page 37 for a key to this chart


NORTH
EAST
WEST
SOUTH
NORTHEAST
NORTHWEST
SOUTHEAST
SOUTHWEST
Summer Triangle
Deneb
HERCULES
DRACO
M39
LACERTA
Alderamin
CEPHEUS
House
January Boötids Peak 16-18 Jan
Quadrantids Peak 4 Jan
January Draconids Peak 13-16 Jan
BOÖTES
M101
Alcor
Mizar
Thuban
Kochab
URSA MINOR
M52
Scheat
Great Square of Pegasus
PEGASUS
M51
M63
URSA MAJOR
CANES VENATICI
M40
Plough
Polaris
CASSIOPEIA
Schedar
W
Cor Caroli
Dubhe
M82
M81
CAMELOPARDALIS
M103
Double Cluster
M110
M31
M32
Alpheratz
COMA BERENICES
Merak
ANDROMEDA
NGC 2403
Mirfak
M34
M33
TRIANGULUM
PISCES
RR
Algol
Hamal
VIRGO
Denebola
LEO MINOR
Capella
PERSEUS
LYNX
AURIGA
Kids
ARIES
M74
7th
M66
M65
LEO
Sickle
Zeta Aurigids Peak 31 Dec
M38
M36
Castor
GEMINI
M37
Elnath
10th
M45
Pleiades
16th
Pollux
CANCER
Jupiter
Uranus
Regulus
Alpha Leonids Peak 24 Jan
Mars
1st
31st
Rho Geminids Peak 8/9 Jan
M44
13th
M35
M1
Hyades
TAURUS
KEY TO
Delta Cancrids Peak 17 Jan
Ecliptic
Aldebaran
Mira
M67
Menkar
SEXTANS
Bellatrix
CANIS MINOR
Celestial Equator
Procyon
Betelgeuse
ORION
ERIDANUS
Alphard
HYDRA
Winter Triangle
MONOCEROS
M78
Mirror of Venus
M42
Zaurak
Rigel
M50
M46
M47
Sirius
LEPUS
PUPPIS
M41
CANIS MAJOR
M79

Visible planets

Where to spot the planets this month

Mercury
Visible low in the dawn twilight, lost after 9 Jan.

Venus
Greatest elongation on 10 Jan, near Saturn on 18 Jan and Neptune on 31 Jan.

Mars
Reaches opposition 16 Jan, presents 14 arcsecond disc through the eyepiece.

Jupiter
Well placed evening planet in Taurus, reaching altitude of 59° when due south.

Saturn
Occulted by the Moon on 4 Jan, early evening.

Uranus
Evening planet in Aries, reaching peak altitude of 55° in darkness all through the month.

Neptune
Deteriorating evening planet, west of south as darkness falls at the start of the month.

January's key Moon phases

FIRST QUARTER
6 Jan

FULL MOON
13 Jan

LAST QUARTER
21 Jan

NEW MOON
29 Jan

February

Look out for the many planetary spectacles this month

1 February Venus near the 13%-lit waxing crescent Moon (evening)

7 February Jupiter near the crescent Moon before setting (morning)

8 February Callisto 3 arcseconds from Jupiter's southern limb (19:08 UT)

9 February Mars very close to the Moon's southern limb (evening)

24 February Titan and its shadow transit Saturn (12:28-18:50 UT)

◁ **The California Nebula**

Tim Jackson, Cheltenham, Gloucestershire,
6 November 2023

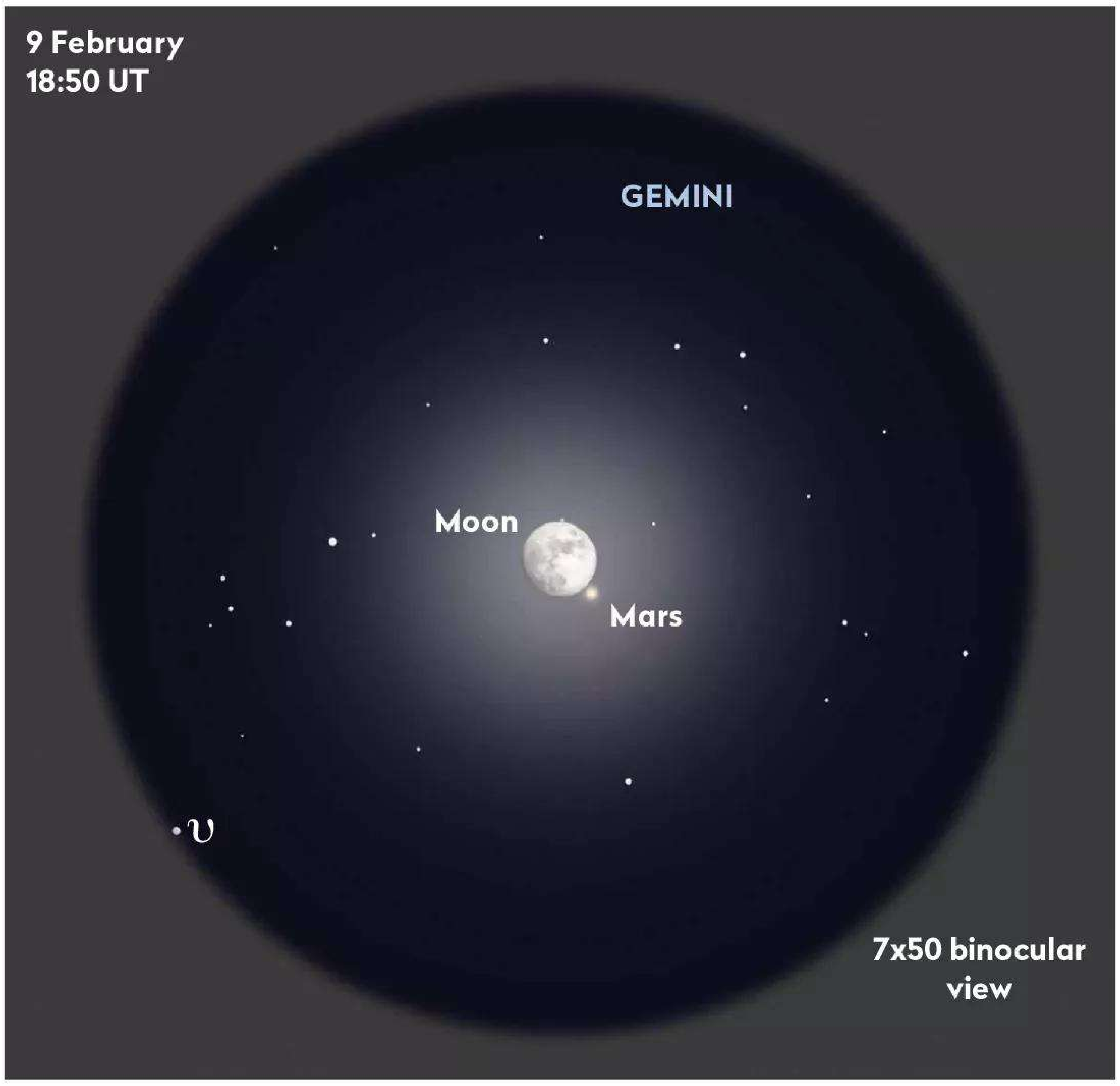
February at a glance

February's night sky showcases the best of the winter constellations in the early evening together with a flavour of spring later in the night, the difference between the two skies being quite marked. Winter's sky is dominated by **Orion, the Hunter**, its seven brightest stars forming a very distinctive pattern with the three unmissable belt stars at its centre. Of similar brightness, the belt stars are arranged equally spaced in a straight line. Hanging south of the belt is the hunter's sword, one of the most viewed regions of the night sky. This is due to the presence of the magnificent and bright **Orion Nebula M42**, along with several other clusters and patches of nebulosity.

The main nebula is full of wispy detail and rewards whatever instrument you use to view it. Located at a distance of 1,344 lightyears, this is an example of an emission nebula. Visible through a small telescope, the four brightest stars in the cluster give it its informal name of the **Trapezium Cluster**. With more than four stars here, see how many you can pick out.

Extend the line of Orion's belt southeast (down and left from the UK) to arrive at the brilliant star **Sirius** (Alpha (α) Canis Majoris) in Canis Major, the Great Dog. Head north-northeast from Sirius until you arrive at the first bright star in this direction, Procyon (Alpha (α) Canis Minoris) in Canis Minor, the Little Dog. Join the dots between Sirius, Procyon and Betelgeuse (Alpha (α) Orionis) in the northeast corner of Orion and you'll have drawn an asterism known as the **Winter Triangle**.

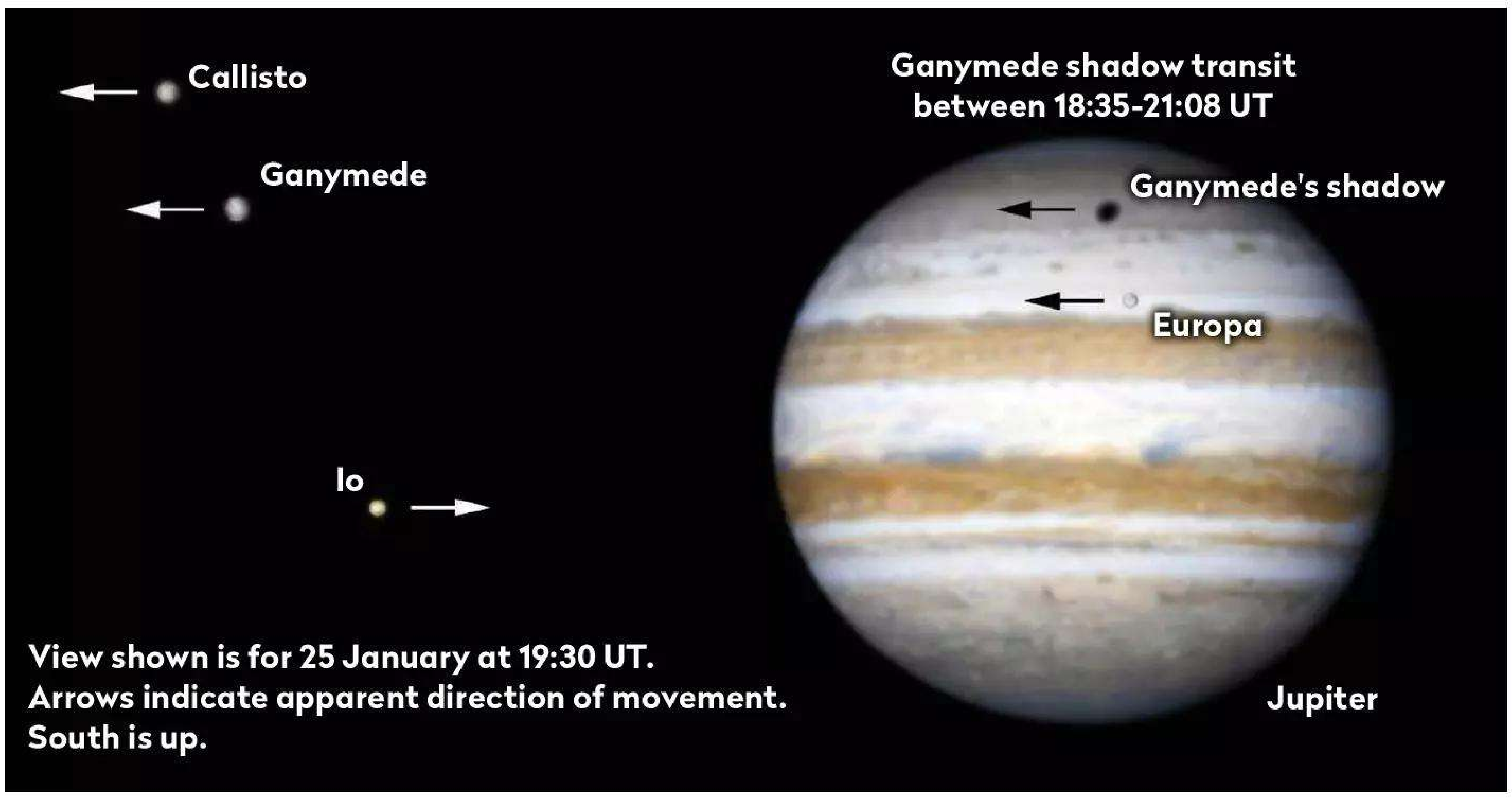
The region around Orion is rich in deep-sky objects due to the presence of the winter Milky Way running down the eastern side of hunter. As it does so, it passes through the Winter Triangle and the faint constellation of **Monoceros, the Unicorn**. Monoceros has a multitude of local deep sky treasures to find including the **Rosette Nebula** (NGCs 2237-39 and 2246) and the associated cluster **NGC 2244**, which is all you can see unless you have dark skies and the use of a nebula filter. It's also the home of the complex region which includes the Christmas Tree Cluster (NGC 2264), Fox Fur Nebula (Sharpless 273) and Cone Nebula (part of NGC 2264), all located on the tip of the Unicorn's horn.



▲ At 18:50 UT on 9 Feb, Mars appears just 4 arcminutes south of the Moon's southern edge

The Milky Way's influence continues as you head north into the feet of **Gemini, the Twins**. Here, you'll find the beautiful and underrated open cluster **M35** near the foot of Castor. Mag. +5.1 M35 is a superb object to view through a small telescope with a smaller, more distant ninth magnitude cluster **NGC 2158** 24-arcminutes to the southwest. Keep heading north from M35 towards bright yellow **Capella** (Alpha (α) Aurigae) in Auriga, the Charioteer and you'll be passing through the region containing three additional Messier clusters; M37, M36 and M38, arrived at in that order.

The spring constellations lie further to the east, beginning with the faint inverted-Y of **Cancer, the Crab** followed by the more defined form of **Leo, the Lion**. However, the absence of Milky Way in this general direction really shows, with the stars and patterns on view having a more subtle appearance than the bright, vibrant stars of winter that surround Orion.



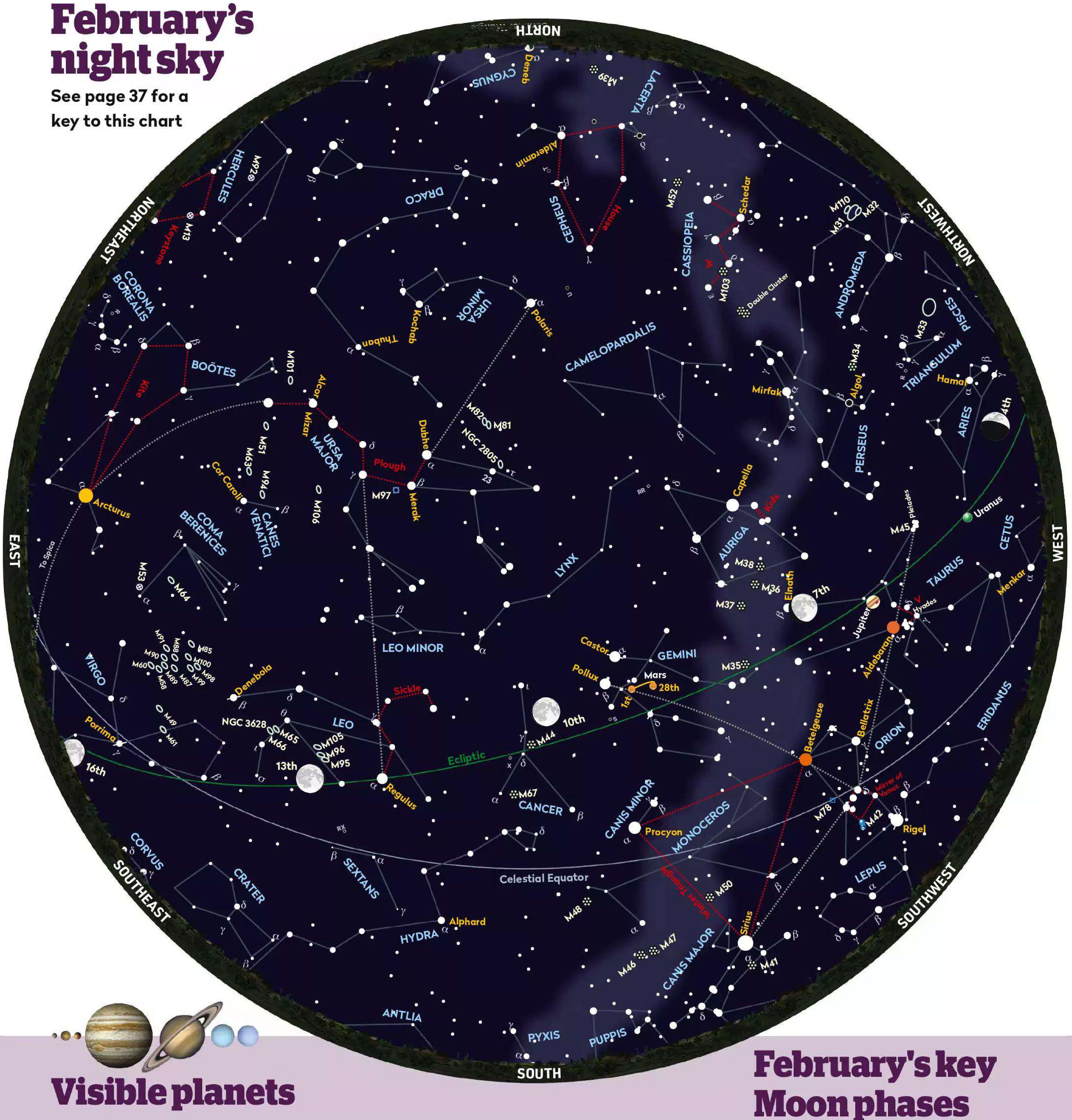
View shown is for 25 January at 19:30 UT. Arrows indicate apparent direction of movement. South is up.

▼ A well-timed Ganymede shadow transit can be seen on the evening of 25 Jan. Europa keeps pace with Ganymede's shadow during the event

PETE LAWRENCE X 3, ISTOCK X 7, NASA X 4

February's night sky

See page 37 for a key to this chart


NORTH
NORTHEAST
EAST
SOUTHEAST
SOUTH
SOUTHWEST
WEST
NORTHWEST
CYGNUS
Deneb
M39
LACERTA
Alderamin
CEPHEUS
House
DRACO
HERCULES
M92
M13
Keystone
CORONA BOREALIS
BOÖTES
Kite
Arcturus
To Spica
URSA MINOR
Kochab
Thuban
Polaris
CASSIOPEIA
Schedar
M52
W
M103
Double Cluster
M110
M31
M32
ANDROMEDA
PISCES
M33
TRIANGULUM
Hamal
ARIES
4th
CAMELOPARDALIS
M34
Algol
Mirfak
PERSEUS
M101
Alcor
Mizar
URSA MAJOR
Plough
Dubhe
Merak
M97
M82
M81
NGC 2805
M51
M63
M94
M106
Cor Caroli
CANES VENATICI
COMA BERENICES
M53
M64
Capella
Kids
AURIGA
M38
M36
M37
Elnath
7th
Pleiades
M45
Uranus
CETUS
TAURUS
Menkar
Jupiter
Hyades
Aldebaran
LYNX
LEO MINOR
VIRGO
M85
M91
M88
M100
M98
M90
M60
M58
M89
M87
M99
Denebola
M49
M61
Porrima
16th
NGC 3628
M65
M66
M105
M96
M95
13th
LEO
Sickle
Regulus
Ecliptic
M44
10th
Castor
Pollux
GEMINI
Mars
28th
1st
M35
Betelgeuse
Bellatrix
ORION
ERIDANUS
M67
CANCER
CANIS MINOR
Procyon
MONOCEROS
M78
Mirror of Venus
M42
Rigel
LEPUS
Winter Triangle
M50
CORVUS
CRATER
SEXTANS
Celestial Equator
M48
HYDRA
Alphard
Sirius
M47
M46
CANIS MAJOR
M41
ANTLIA
PYXIS
PUPPIS

Visible planets

Where to spot the planets this month

Mercury
Superior conjunction 9 Feb. Visible approximately 30 minutes after sunset on 25 Feb, 1.5° from Saturn.

Mars
Evening planet over 60° altitude when due south. Very near Moon on 9 Feb at 18:50 UT.

Saturn
Deteriorating evening planet. Best at start of February. Near waxing Moon and Venus on 1 Feb.

Venus
Evening planet, visible soon after sunset. Near 13%-lit waxing Moon on 1 Jan.

Jupiter
Well-placed evening planet. Near waxing gibbous Moon on the morning of 7 Feb.

Uranus
Well positioned evening planet in Aries, best at the start of the month.

February's key Moon phases

FIRST QUARTER
5 Feb

FULL MOON
12 Feb

LAST QUARTER
20 Feb

NEW MOON
28 Feb

URSA MAJOR
Megrez
δ
ε
Plough
Alioth
ζ
γ
Phecda
M109
Alcor
Mizar
NGC 3953
M101
5
χ
3
Alkaid
η
21
24
M106
TU
NGC 5195
M51
NGC 4051
NGC 3938
Y
NGC 4449
5°
N
E
W
S
β
NGC 4490
Chara
M63
M94
NGC 4151
20
6
NGC 4244
Cor Caroli
α
NGC 4214
NGC 5005
NGC 5033
25
14
NGC 4631
NGC 4414
CANES VENATICI
γ
NGC 4559
NGC 5466
M3
β
Melotte 111
NGC 4565
NGC 4494
NGC 4725
COMA BERENICES
BOÖTES
M64

Constellation of the season

SPRING: Canes Venatici

The constellation of Canes Venatici, the Hunting Dogs requires a stretch of the imagination to visualise. In the sky, it's basically a line connecting the star Cor Caroli (Alpha (α) Canum Venaticorum) to Chara (Beta (β) Canum Venaticorum). The constellation represents two greyhounds held on a leash by Boötes, the Herdsman.

The two dogs are a male called Asterion which means 'starry' and a female named Chara which means 'dear'. Asterion is further to the north in a region of sky marked by nothing more than a sparse scattering of faint stars.

The star Cor Caroli is named in honour of King Charles I of England, the name meaning 'Charles's Heart'. In terms of the dogs, or rather dog, it represents the joint on Chara's collar where it's attached to the leash. One way to visualise the location of Cor Caroli is to first identify the Plough or Saucepan asterism, specifically the handle. This traces out an arc in the sky. Imagine the arc as being part of a circle and mag. +2.9 Cor Caroli sits at the approximate centre of that circle.

Explore the local vicinity

Imagine Chara as a pivot. Rotate the Cor Caroli to Chara line 90° clockwise around Chara, and where the Cor Caroli end would finish up marks the position of mag. +5.4 Y Canum Venaticorum, also known as La Superba. You might think the informal name for this striking red star originates from its strong colour, but that's not the case. Y Canum Venaticorum is a semi-regular variable changing brightness by around one magnitude over an approximately 160-day period. It was given the name La Superba by 19th-century astronomer Father Angelo Secchi, because of the beauty of its spectrum, which shows regions of bright red, yellow and green separated by broad spaces.

To find the bright mag. +9.3 Sunflower Galaxy M63, rotate the Chara-Cor line around Cor Caroli by 90° counter-clockwise. Spiral galaxy M63 sits at the free Chara end. This object gets its informal name from its mottled granular appearance, which resembles the texture of the inner part of a sunflower.

Amazingly, the muti-purpose line hasn't exhausted its uses either because it can also be used to find another bright galaxy, mag. +8.2 M94, the Cat's Eye Galaxy. This time, imagine the mid-point of the line then head at right angles in a northerly direction for one-third of the line's length, where you will reach M94.

But the most impressive galaxy within Canes Venatici is undoubtedly M51, the Whirlpool Galaxy. Locate the star at the end of the Plough handle called Alkaid (Eta (η) Ursae Majoris). From Alkaid, identify mag. +4.7 24 Canum Venaticorum, 2.1° west and slightly south of mag. +1.8 Alkaid. From 24 Canum Venaticorum, head a similar distance south-southwest to locate M51. At mag. +8.4 it can be seen through binoculars but a telescope is needed to reveal its spiral structure. The Whirlpool's spiral arms are better defined than those of M94, visible under dark sky conditions with a 150mm scope. A 100mm scope will show M51 as a smudge with a smaller smudge nearby. The smaller smudge is M51's gravitationally bound companion galaxy NGC 5195.

Bright mag. +6.4 globular cluster M3 is located right on the southern boundary of Canes Venatici where it joins to neighbouring Boötes. M3 is a beautiful object through a telescope, second only to M13 in Hercules.

▼ Left: The mottled, granular appearance of M63 is said to resemble the texture of the centre of a sunflower, hence its popular name of the Sunflower Galaxy

Right: M3 is a bright globular cluster within Canes Venatici, midway between Cor Caroli and Arcturus

ALL PICTURES: PETE LAWRENCE

March

Don't miss the partial solar eclipse and total lunar eclipse this month

4 March Double shadow transit on Jupiter (23:36-01:13 UT)

6 March Lunar X clair-obscur effect visible on the Moon (around 23:00 UT)

14 March Total lunar eclipse (sets during totality from the UK)

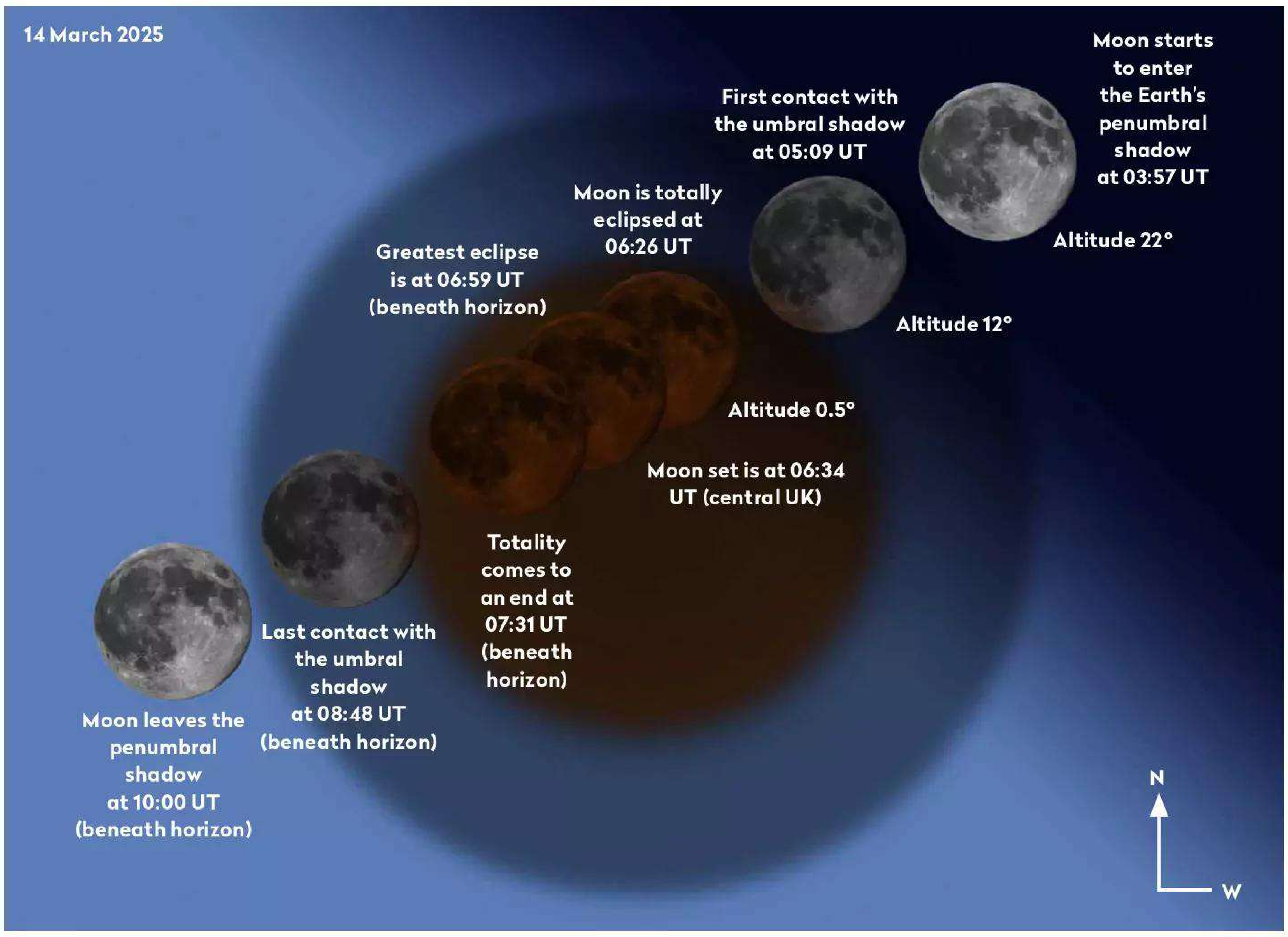
20 March March equinox

29 March Partial solar eclipse

The Andromeda Galaxy ▷

Oliver Carter, Leesburg, Virginia, USA, 1–21 September 2023

March at a glance


14 March 2025
Moon starts to enter the Earth's penumbral shadow at 03:57 UT
Altitude 22°
First contact with the umbral shadow at 05:09 UT
Altitude 12°
Moon is totally eclipsed at 06:26 UT
Greatest eclipse is at 06:59 UT (beneath horizon)
Altitude 0.5°
Moon set is at 06:34 UT (central UK)
Totality comes to an end at 07:31 UT (beneath horizon)
Last contact with the umbral shadow at 08:48 UT (beneath horizon)
Moon leaves the penumbral shadow at 10:00 UT (beneath horizon)
N
W

▲ The Moon experiences a total eclipse on the morning of 14 March. From the UK it reaches totality just before setting

PETE LAWRENCE X 3, ISTOCK X 7, NASA X 4

March is a busy month with two eclipses, two inner planets dive-bombing the Sun and Saturn's invisible ring plane crossing.

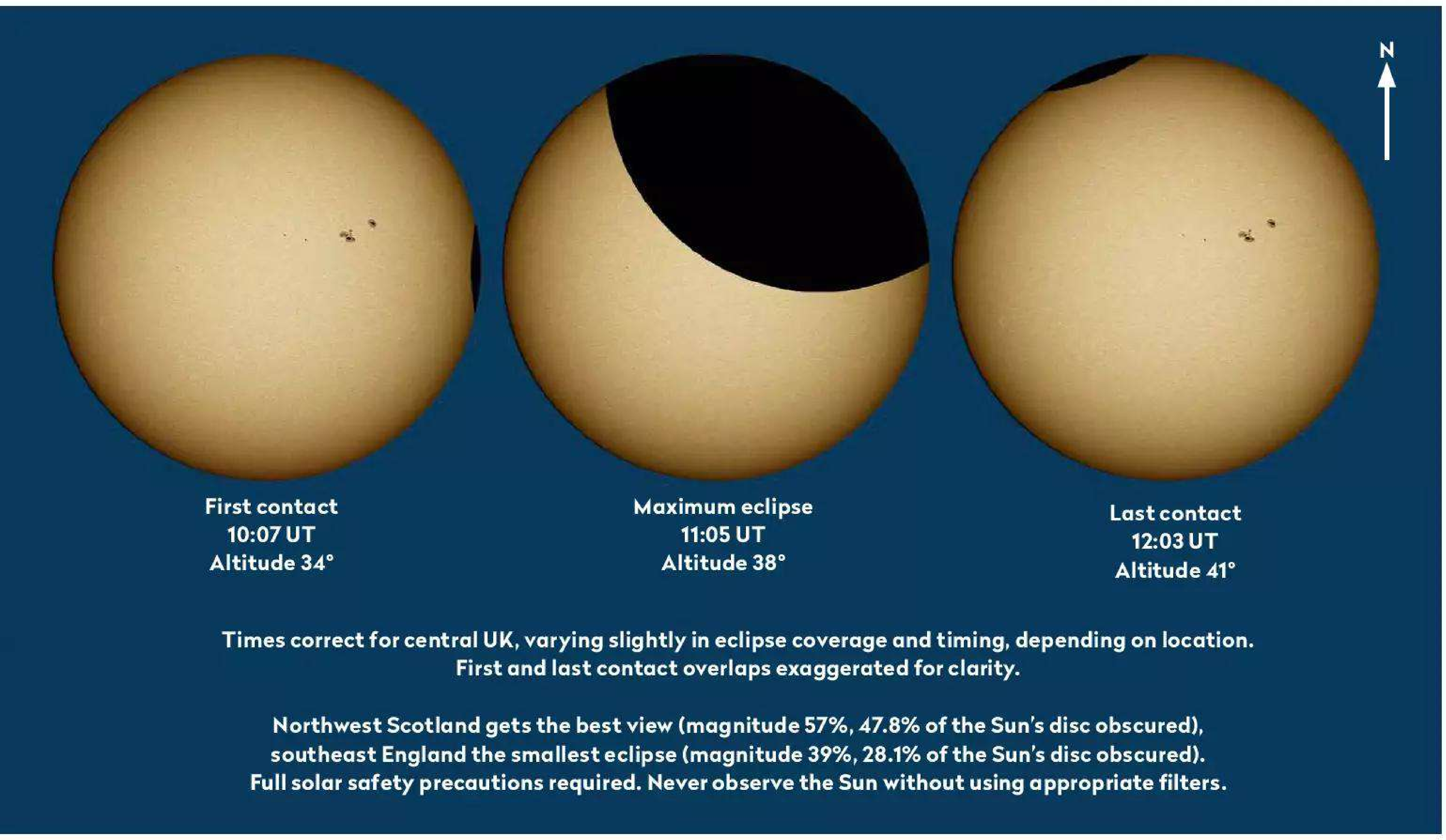
On 14 March, there's a total lunar eclipse which isn't optimal for the UK, totality occurring around moonset, the sky brightening due to morning twilight.

The subtle penumbral part of this eclipse begins at 03:57 UT on 14 March, the full Moon being 22° above the west-southwest horizon. Unlikely to be noticeable at first, it becomes more obvious near the Moon's southwestern limb just before the umbral shadow appears at 05:10 UT. Located 11° above the western horizon at 05:10 UT, a partial eclipse can be seen until totality is reached at 06:26 UT.

The partial solar eclipse on 29 March is easier to see, in the late morning. From the UK's centre, almost 50% of the Sun's diameter will appear covered by the Moon (about 35% of its area).

At the start of March, Mercury and Venus are bright in the evening sky. On 1 March, Mercury is at mag. -0.9, setting 90 minutes after the Sun with a 3%-lit waxing crescent Moon 7° east-northeast of the planet. The following evening, Mercury is 1.9° from dim Neptune. Greatest eastern elongation occurs on 8 March, Mercury appearing 18.2° from the Sun. On 12 March, having now dimmed to mag. +0.7, Mercury appears 5.6° south of mag. -4.2 Venus. Moving along the part of its orbit closest to Earth, Mercury slips rapidly into the Sun's glare to reach inferior conjunction on 24 March.

Venus appears impressive at the start of March, a mag. -4.4 jewel in the evening sky, setting over three hours after the Sun on 1 March. A telescope shows the planet as a spectacular 13%-lit crescent, 49 arcseconds across. After posing near the 10%-lit waxing crescent Moon on 2 March and Mercury on 12 March, Venus too rapidly heads towards inferior conjunction on 23 March. Venus does re-emerge into the morning sky at the end of the month.


N
First contact
10:07 UT
Altitude 34°
Maximum eclipse
11:05 UT
Altitude 38°
Last contact
12:03 UT
Altitude 41°

Times correct for central UK, varying slightly in eclipse coverage and timing, depending on location. First and last contact overlaps exaggerated for clarity.

Northwest Scotland gets the best view (magnitude 57%, 47.8% of the Sun's disc obscured), southeast England the smallest eclipse (magnitude 39%, 28.1% of the Sun's disc obscured). Full solar safety precautions required. Never observe the Sun without using appropriate filters.

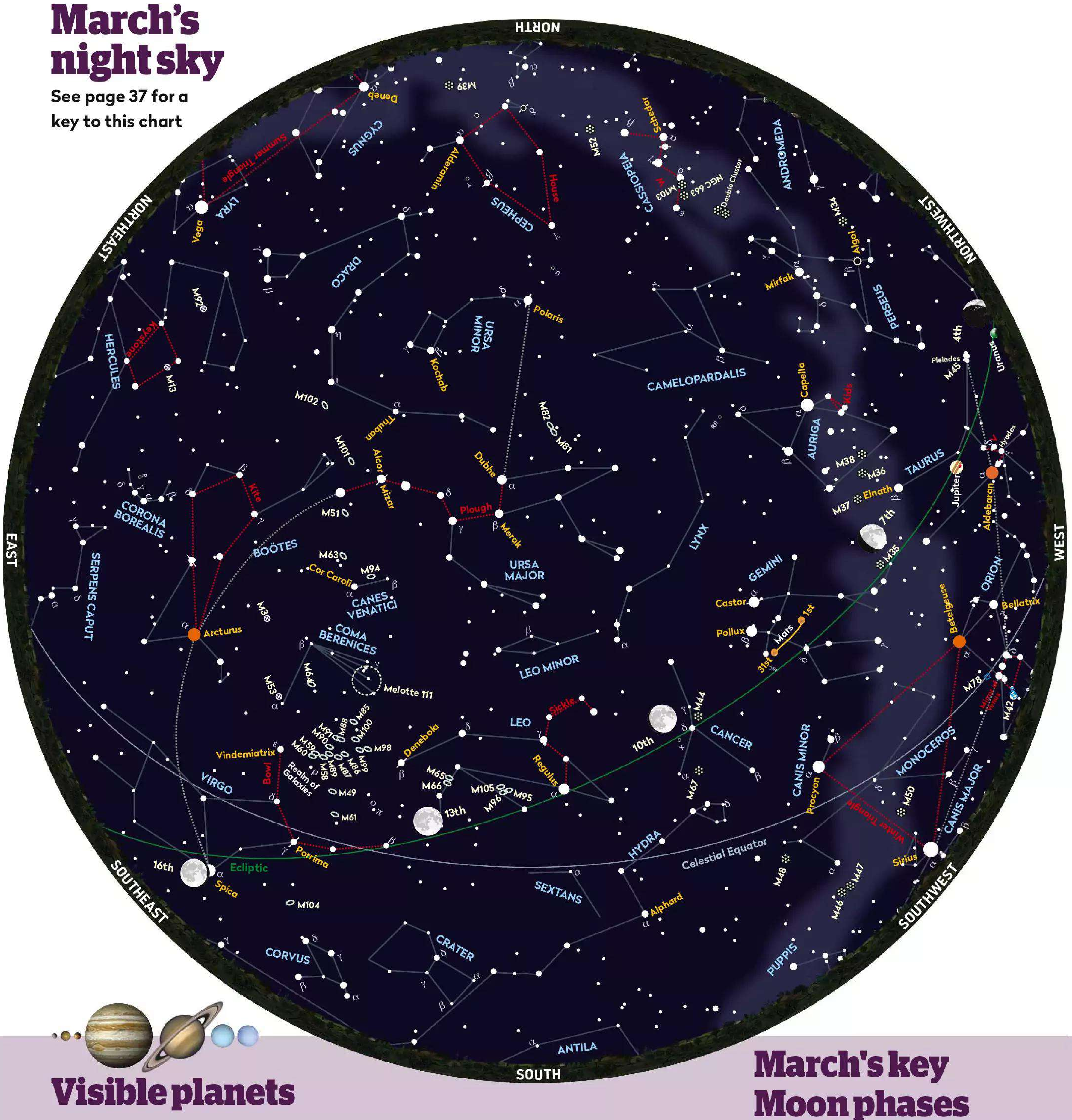
▼ During the partial solar eclipse, a lot of the Sun's disc will be covered by the Moon

If you've seen Saturn through a telescope lately, you'll know the rings have appeared very thin of late as Saturn's tilt towards Earth decreases. This comes to a head on 23 March when Saturn appears to undergo a ring plane crossing. If the planet were visible, the rings would effectively disappear from view for a short while, but solar conjunction on 12 March means we won't see this.

Jupiter is still visible during March. On 4/5 March, Ganymede and Europa's shadows create a double shadow transit visible from 23:56-01:13 UT. On 5 March, Callisto appears just 1-arcsecond north of Jupiter's northern limb at 19:57 UT.

March's night sky

See page 37 for a key to this chart


NORTH
NORTHEAST
EAST
SOUTHEAST
SOUTH
SOUTHWEST
WEST
NORTHWEST
Deneb
M39
CYGNUS
Summer Triangle
Vega
LYRA
Alderamin
CEPHEUS
House
M52
Schedar
CASSIOPEIA
M103
NGC 663
Double Cluster
ANDROMEDA
M34
Algol
Mirfak
PERSEUS
DRACO
M92
HERCULES
Keystone
M13
URSA MINOR
Polaris
Kochab
CAMELOPARDALIS
Pleiades
M45
4th
Uranus
Capella
Kids
AURIGA
M102
Thuban
M82
M81
M101
Alcor
Mizar
Dubhe
Plough
Merak
M38
M36
Elnath
M37
TAURUS
Hyades
Jupiter
Aldebaran
7th
M35
CORONA BOREALIS
Kite
BOÖTES
M51
M63
Cor Caroli
M94
CANES VENATICI
URSA MAJOR
LYNX
GEMINI
Castor
Pollux
Mars
1st
31st
ORION
Bellatrix
Betelgeuse
SERPENS CAPUT
Arcturus
M3
COMA BERENICES
M64
Melotte 111
M53
LEO MINOR
M44
10th
CANCER
M78
Winter Triangle
M42
LEO
Sickle
Regulus
Vindemiatrix
Bowl
Realm of Galaxies
M91
M90
M88
M85
M100
M98
M59
M60
M58
M89
M87
M86
M84
M49
M61
Denebola
M65
M66
M105
M96
M95
13th
CANIS MINOR
Procyon
MONOCEROS
M50
CANIS MAJOR
Sirius
M67
VIRGO
Porrima
HYDRA
Celestial Equator
Ecliptic
16th
Spica
SEXTANS
M48
M47
M46
Alphard
M104
CORVUS
CRATER
PUPPIS
ANTILA

Visible planets

Where to spot the planets this month

Mercury
Evening planet at start of March, greatest eastern elongation 8 March. Lost from view mid-month.

Venus
Evening planet, sets over 3 hours after sunset on 1 March, lost after mid-month.

Mars
Evening planet, 56-arcminutes south of 74%-lit waxing gibbous Moon on 9 March.

Jupiter
Despite losing the battle with brightening evening twilight, remains a decent altitude throughout March.

Saturn
Not visible, ring plane crossing on 23 March.

Uranus
Loses altitude due to brightening spring skies throughout the month.

Neptune
Not visible this month.

March's key Moon phases

FIRST QUARTER
6 Mar

FULL MOON
14 Mar

LAST QUARTER
22 Mar

NEW MOON
29 Mar

April

Don't miss the Lyrid meteor shower and Jewelled Handle clair-obscur effect

1 April The Moon occults the Pleiades open cluster (evening)

8 April Jewelled Handle clair-obscur effect visible on the Moon (early morning)

16 April Callisto appears to almost touch Jupiter's southern pole (22:40 BST (21:40 UT))

22 April Lyrid meteor shower peak

25 April Venus near the Moon (dawn)

The Moon over Bath ▷

Alex Bell, Bath, Somerset, 18 January 2024

April at a glance

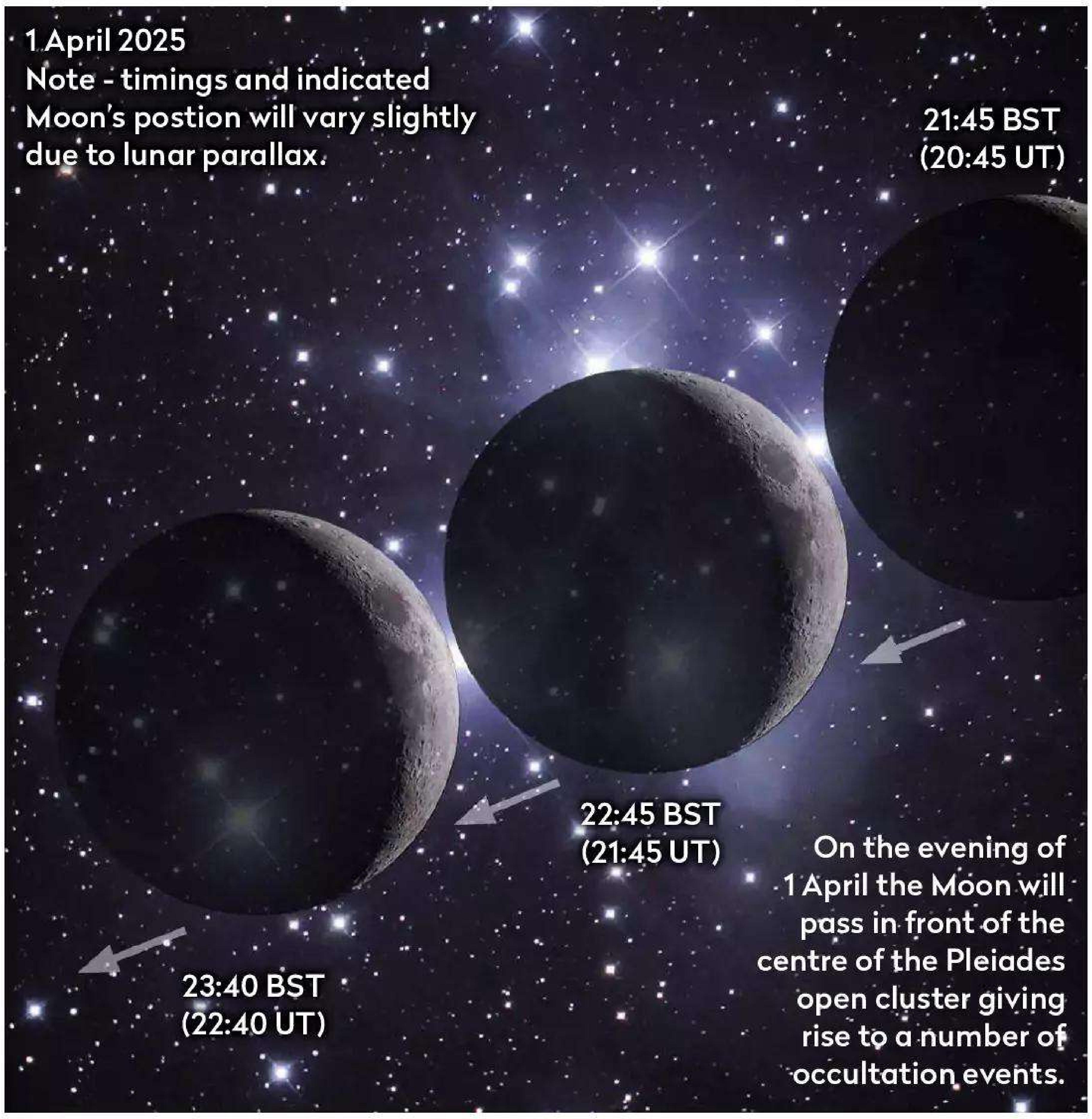
The period of night shrinks rapidly with the spring sky dominating the evening view, **Leo, the Lion** nicely displayed. The main characteristic of Leo is an asterism rising north from Regulus (Alpha (α) Leonis). Called the **Sickle**, it represents the lion's head and looks like a large backward-facing question mark. The body extends to the east, roughly rectangular in shape with two pairs of legs dangling south. Further east still, the lion's tail is marked by second magnitude **Denebola** (Beta (β) Leonis).

Follow the direction the tail is pointing to a region of sky known as the **Realm of Galaxies**. Sitting just to the north of another large asterism, known as the **Bowl of Virgo**, the realm is full of faint fuzzy galaxies from the Virgo Galaxy Cluster and Coma Galaxy Cluster.

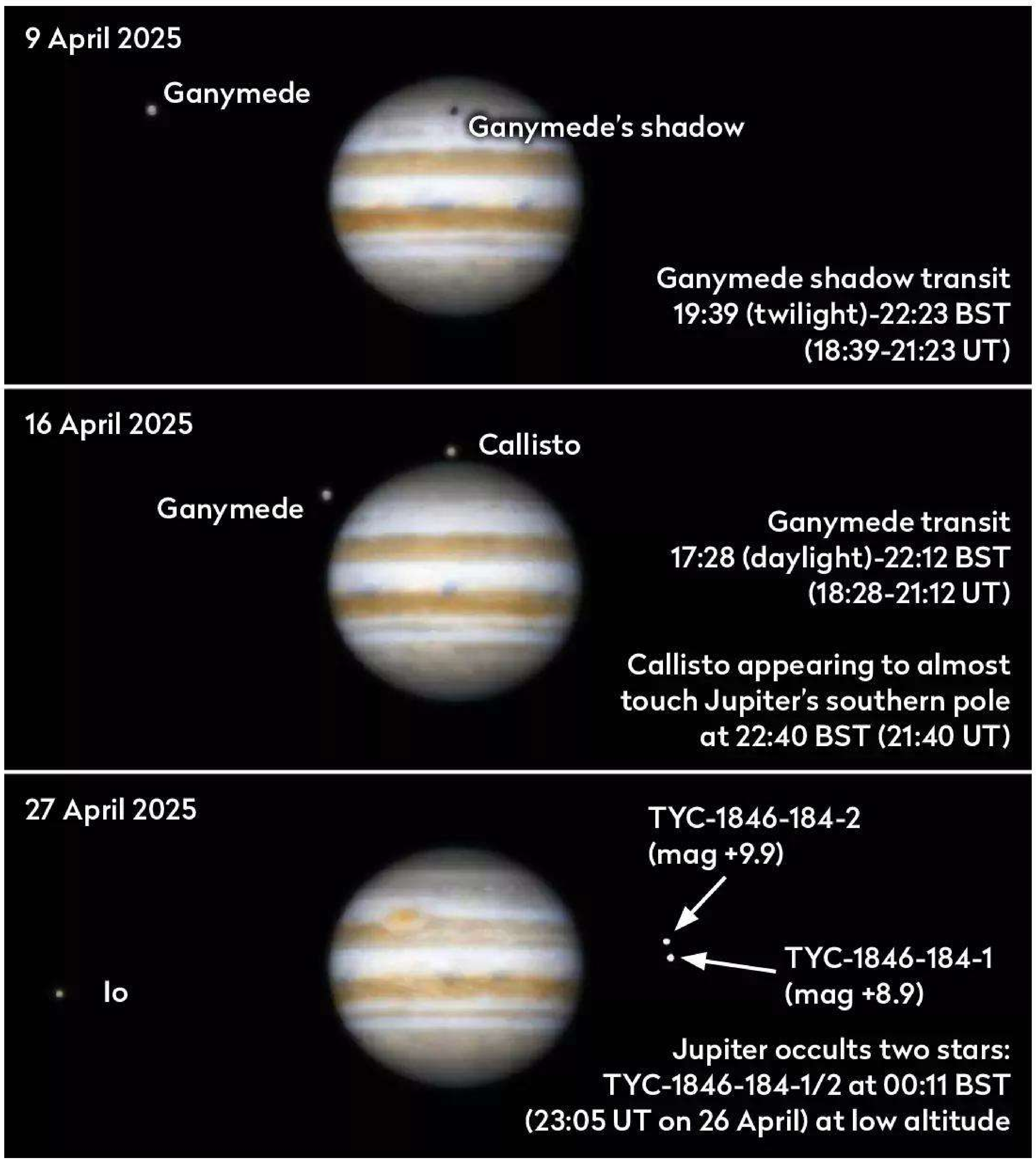
Virgo is a large, sprawling constellation; the second largest by area in the night sky. The principal star is **Spica** (Alpha (α) Virginis). To locate Spica, first find the Plough or Saucepan asterism, which is part of Ursa Major, the Great Bear. At this time of year, the pattern sits overhead. Extend the arc of the Saucepan's curving handle away from the pan to eventually arrive at bright orange Arcturus (Alpha (α) Boötis), which sits at the bottom pointed-end of a large kite-shaped asterism. The Kite is as high as the Saucepan is long. Keep the Saucepan handle arc going through Arcturus and eventually you'll arrive at bright white Spica. One way to visualise Spica and the Bowl of Virgo is to think of Spica as the base of the stem of a giant letter 'y', the Bowl can then be visualised forming the upper half of the character. Heading north from Porrima (Gamma (γ) Virginis) at the base of the Bowl – where the three 'arms' of the 'y' join, you'll be passing directly up through the Realm of Galaxies. One striking region within the realm is known as **Markarian's Chain**, a curving chain of galaxies of various sizes and shapes.

Keep heading north out of the Realm of Galaxies and you'll pass up through the triangular open cluster known as **Mellote 111**, part of **Coma Berenices, Queen Berenice's Hair**; the cluster represents the queen's flowing hair. Keep heading north and you'll pass up through the unassuming pair of stars which form Canes Venatici, the Hunting Dogs (see page 46). They don't look too much like dogs, but the constellation along with Coma Berenices to the south also contains a number of impressive galaxies. The most famous example has to be **Whirlpool Galaxy M51**, which is located 3.6° southwest of Alkaid (Eta (η) Ursae Majoris).

The early phases of the Moon are well placed in the evening sky at this time of year. The popular clair-obscur (trick of the light) effect, known as the **Jewelled Handle** is visible in the early hours of 8 April. Formed when the lunar dawn light catches the peaks of the curved Jura Mountain range that borders Sinus Iridum, it's one of the easier clair-obscur effects to see.


1 April 2025
Note - timings and indicated Moon's postion will vary slightly due to lunar parallax.
21:45 BST
(20:45 UT)
22:45 BST
(21:45 UT)
23:40 BST
(22:40 UT)

On the evening of 1 April the Moon will pass in front of the centre of the Pleiades open cluster giving rise to a number of occultation events.

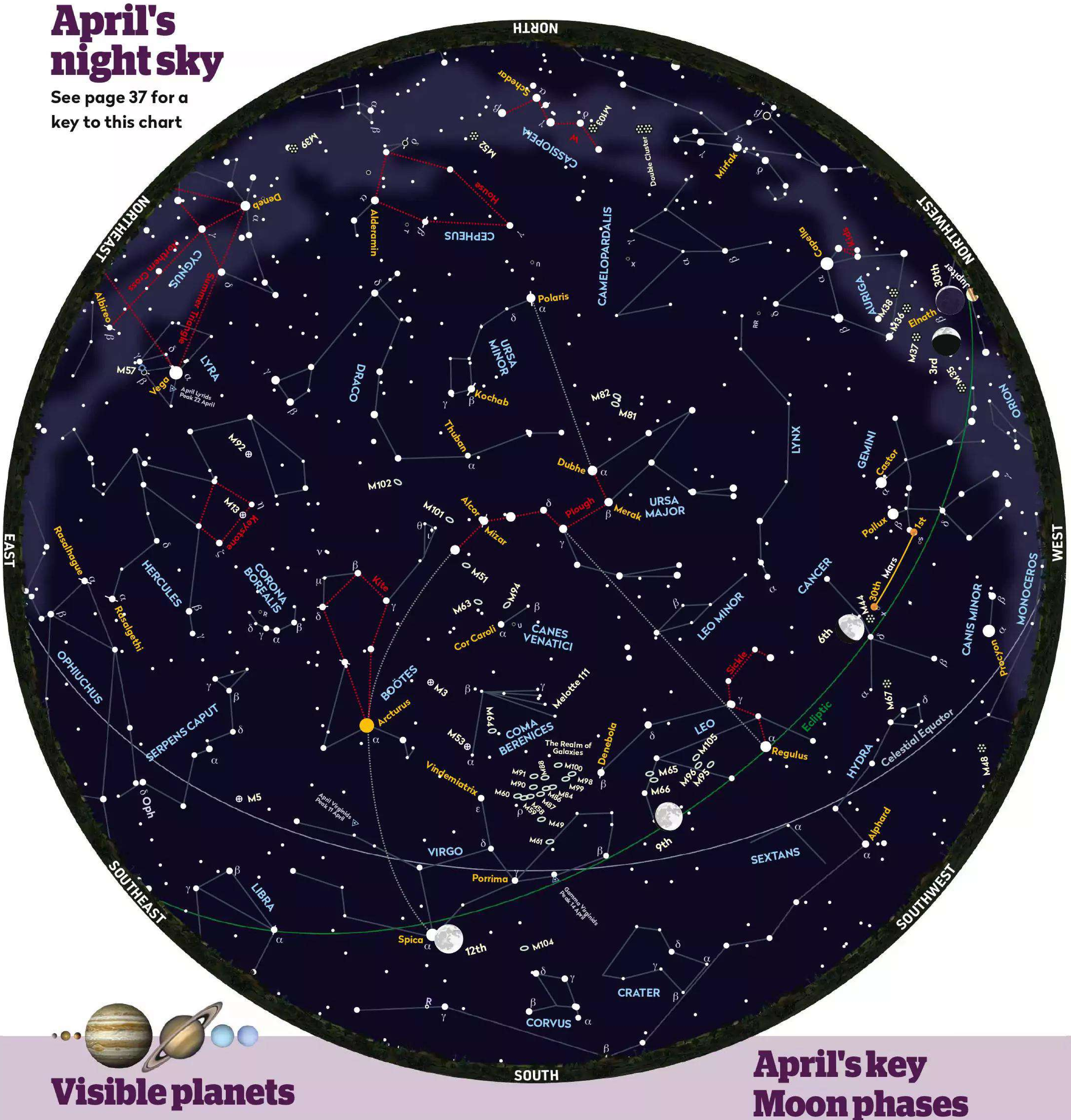

9 April 2025
Ganymede
Ganymede's shadow
Ganymede shadow transit
19:39 (twilight)-22:23 BST
(18:39-21:23 UT)
16 April 2025
Callisto
Ganymede
Ganymede transit
17:28 (daylight)-22:12 BST
(18:28-21:12 UT)
Callisto appearing to almost touch Jupiter's southern pole at 22:40 BST (21:40 UT)
27 April 2025
TYC-1846-184-2
(mag +9.9)
TYC-1846-184-1
(mag +8.9)
Io
Jupiter occults two stars:
TYC-1846-184-1/2 at 00:11 BST
(23:05 UT on 26 April) at low altitude

▲ Jupiter is involved with a number of interesting events this month

PETE LAWRENCE X 3, ISTOCK X 7, NASA X 4

April's night sky

See page 37 for a key to this chart


NORTH
NORTHEAST
EAST
SOUTHEAST
SOUTH
SOUTHWEST
WEST
NORTHWEST
Schedar
CASSIOPEIA
W
M103
M52
M39
Double Cluster
Mirfak
House
CEPHEUS
Alderamin
Deneb
CYGNUS
Northern Cross
Summer Triangle
Albireo
M57
Vega
LYRA
April Lyrids Peak 22 April
CAMELOPARDALIS
Capella
Kids
AURIGA
M38
M36
Elnath
M37
M35
Jupiter
30th
3rd
Polaris
URSA MINOR
Kochab
DRACO
Thuban
M82
M81
M92
M13
Keystone
HERCULES
Rasalhague
Rasalgethi
CORONA BOREALIS
R
M102
M101
Alcor
Mizar
Plough
Dubhe
Merak
URSA MAJOR
LYNX
GEMINI
Castor
Pollux
1st
Mars
30th
M44
CANCER
6th
LEO MINOR
CANIS MINOR
Procyon
MONOCEROS
ORION
Kite
M51
M63
M94
Cor Caroli
CANES VENATICI
BOÖTES
M3
Arcturus
Melotte 111
M64
COMA BERENICES
M53
The Realm of Galaxies
M100
M91
M88
M98
M90
M99
M60
M86
M84
M87
M59
M58
M49
M61
Vindemiatrix
Denebola
OPHIUCHUS
SERPENS CAPUT
M5
δ Oph
April Virginids Peak 11 April
VIRGO
Porrima
Gamma Virginids Peak 14 April
Sickle
Ecliptic
LEO
Regulus
M105
M65
M66
M96
M95
9th
HYDRA
M67
Celestial Equator
M48
SEXTANS
Alphard
LIBRA
Spica
12th
M104
CRATER
CORVUS

Visible planets

Where to spot the planets this month

Mercury
Morning planet, not visible despite reaching greatest western elongation of 27.4° on 21 April.

Venus
Morning planet, rises 70 mins before sunrise. Forms a small triangle with Saturn and Neptune. 10%-lit waning Moon in triangle on 25 April.

Mars
Deteriorating evening planet. 1.6° south of a 57%-lit waxing Moon on evening of 5 April.

Jupiter
Evening planet, deteriorating through the month. Moon nearby on 2 and 30 April.

Saturn
Hard to see in the morning twilight. Near Venus 23 April.

Uranus
Evening planet, visible near a 16%-lit waxing Moon on 1 April, but rapidly lost.

Neptune
Not visible this month.

April's key Moon phases

FIRST QUARTER
5 Apr

FULL MOON
13 Apr

LAST QUARTER
21 Apr

NEW MOON
27 Apr

May

Mars lies near the Beehive Cluster and there's an unusual shadow transit of Titan

2 May Vesta reaches opposition, potentially naked-eye visible (evening)

4 May Mars near the Beehive Cluster (evening)

5 May Lunar X clair-obscur effect visible on the Moon (01:14 BST (00:14 UT))

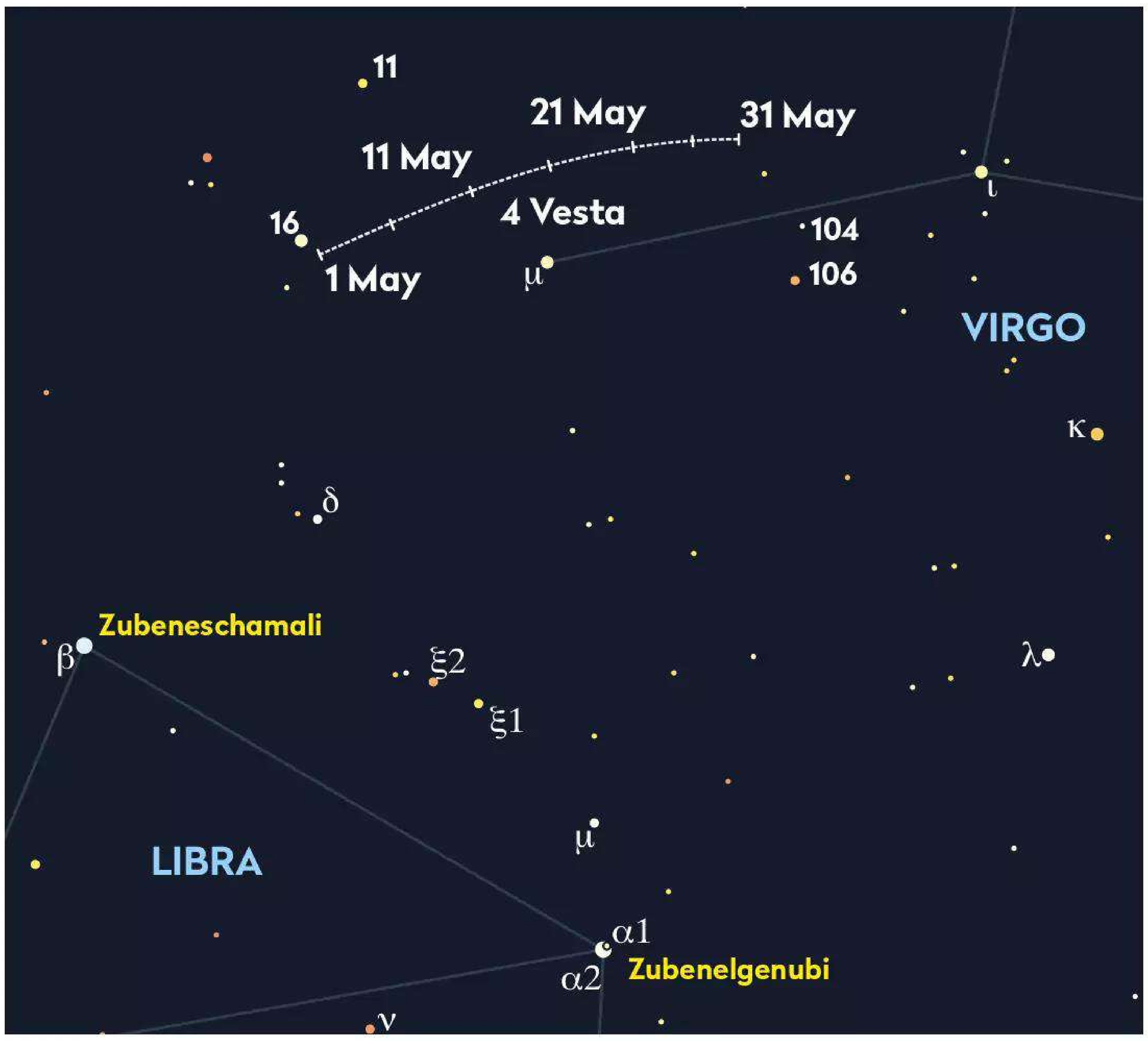
15 May Unusual daylight transit of Titan shadow across Saturn

23 May Approximate start of the Northern Hemisphere's noctilucent cloud season

The Tarantula Nebula ▷

Kfir Simon, Tivoli Farm, Namibia, August 2023

May at a glance



▲ Vesta reaches opposition on 2 May when it may just be visible to the unaided eye from a dark sky site

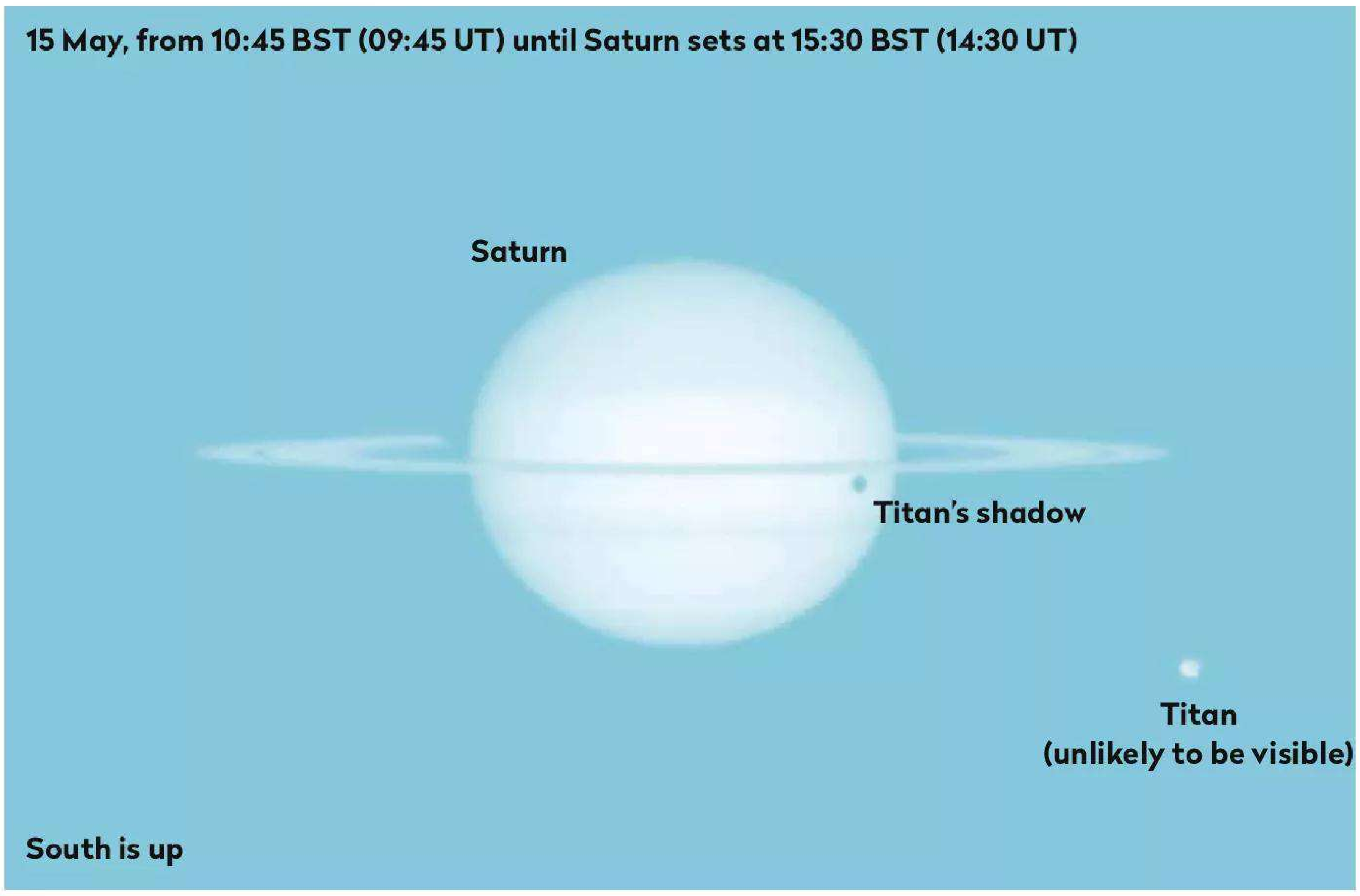
There's a rapid loss of night this month as we head towards the Northern Hemisphere's summer solstice on 21 June. True darkness doesn't arrive for most of the UK until the end of the month. Although this causes issues with seeing faint wispy deep sky objects, there is an upside – the start of **noctilucent cloud** (NLC) spotting season, typically active until early August. Last year saw some excellent NLC displays, so there's all to play for (see page 62 for more details).

The minor planet **4 Vesta** reaches opposition in Libra on 2 May and, excitingly, there's a chance to spot it with the naked eye from a dark site. It's expected to shine at mag. +5.8 for a few days either side of opposition, which is very close to the naked eye threshold and a similar typical brightness to that of Uranus. The Moon is a 23%-lit waxing crescent on 2 May, setting in the early hours around 02:15 BST (01:15 UT) and shouldn't be too much of a nuisance.

The just past first quarter Moon is fortunately quite low for the peak of the **Eta Aquariid meteor shower** expected on the morning of 5 May. This is a tricky shower to observe from the UK due to its low altitude radiant which doesn't rise until the early hours. The best strategy is to keep watch from 02:00 BST (01:00 UT) until 03:00 BST (02:00 UT). In this short window it you do manage to see an Eta Aquariid meteor you'll be witnessing a tiny piece of comet 1P/Halley vaporising in Earth's atmosphere. The low Moon sets around 03:30 BST (02:30 UT).

Transits of **Titan** and its shadow occur in batches separated by around 15 years and even then, timings for these infrequent events may not be ideal. This is certainly the case for a special transit of Titan's shadow on 15 May which happens during daylight. Saturn is visible during the day through a telescope, but it has very low contrast, making it appear a ghost of its night time self. The best strategy is to pick it up with an equatorially driven telescope in the pre-sunrise sky and then, if practical, stay with it. For this event, the shadow alignment places it adjacent to the section of rings nearest Earth.

The stars and constellations visible in the earlier part of the night are those of spring, but there's a transition taking place in the early hours as the stars of summer begin to take over. The kite-shaped constellation of **Boötes, the Herdsman** rides high across the May sky, with the beautifully compact semi-circular pattern of **Corona Borealis** just to the east of it. East of Corona Borealis is the sprawling form of **Hercules, the Strongman**, its most distinctive shape being the relatively faint pattern known as the **Keystone**. This is the guide to locating a beautiful showpiece of spring, **M13** the Great Globular in Hercules. Located one third of the way down from the northwest corner of the Keystone towards the southwest corner, this globular is estimated to contain upwards of 100,000 stars. M13 is just visible to the naked eye as a fuzzy star from a dark sky location, but it is really quite stunning through a telescope.

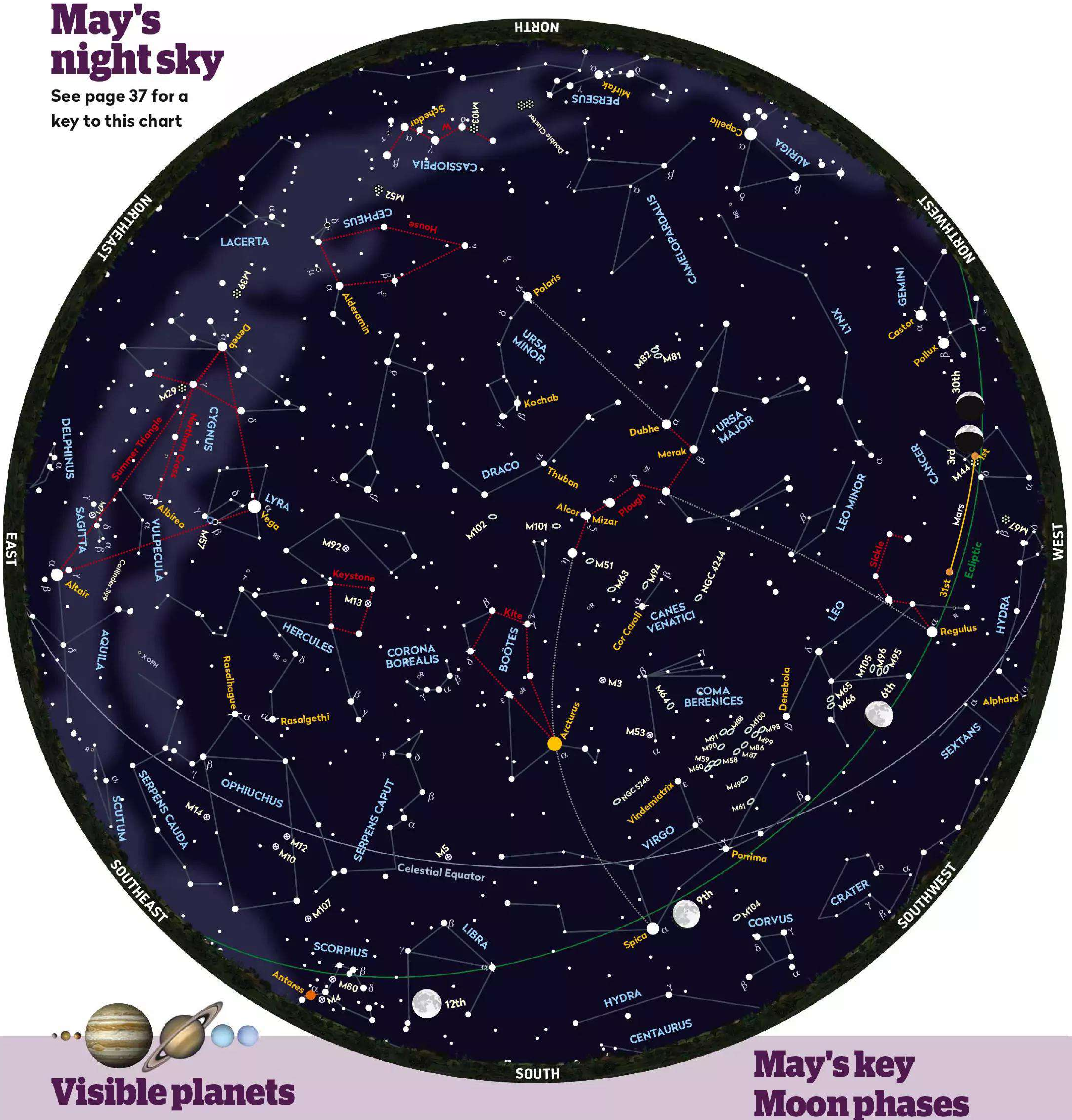

15 May, from 10:45 BST (09:45 UT) until Saturn sets at 15:30 BST (14:30 UT)

▼ A tricky daylight Titan shadow transit occurs on 15 May, unusual due to the shadow's proximity to the edge of the rings

PETE LAWRENCE X 3, ISTOCK X 7, NASA X 4

May's night sky

See page 37 for a key to this chart


NORTH
NORTHEAST
NORTHWEST
EAST
WEST
SOUTHEAST
SOUTHWEST
SOUTH
PERSEUS
Mirfak
Double Cluster
CASSIOPEIA
Schedar
W
M103
Capella
AURIGA
M52
CEPHEUS
House
LACERTA
CAMELOPARDALIS
M39
Alderamin
Polaris
GEMINI
Castor
Pollux
LYNX
Deneb
URSA MINOR
M82
M81
M29
Kochab
CYGNUS
Summer Triangle
Northern Cross
DELPHINUS
Dubhe
URSA MAJOR
Merak
DRACO
Thuban
CANCER
M44
Mars
LYRA
Vega
Albireo
SAGITTA
M27
VULPECULA
M57
Alcor
Mizar
Plough
M102
M101
M92
LEO MINOR
M67
Ecliptic
Sickle
Altair
Collinder 399
Keystone
M51
M63
M94
NGC 4244
CANES VENATICI
Cor Caroli
M13
Kite
LEO
Regulus
HYDRA
AQUILA
HERCULES
CORONA BOREALIS
BOÖTES
M3
COMA BERENICES
M64
Denebola
M105
M96
M95
M65
M66
Alphard
Rasalhague
Rasalgethi
Arcturus
M53
M88
M100
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M90
M86
M99
M87
M59
M60
M58
SEXTANS
SERPENS CAUDA
OPHIUCHUS
SERPENS CAPUT
NGC 5248
Vindemiatrix
M49
M61
SCUTUM
M14
M12
M10
M5
VIRGO
Porrima
Celestial Equator
M107
M104
CORVUS
CRATER
Spica
LIBRA
SCORPIUS
Antares
M80
M4
HYDRA
CENTAURUS
1st
3rd
6th
9th
12th
30th
31st

Visible planets

Where to spot the planets this month

Mercury
Morning planet, too low to be seen properly from UK.

Venus
Morning planet, lowering so hard to see before sunrise.

Mars
Evening planet, best at start of May. Crosses the Beehive Cluster M44 on 4 May.

Jupiter
Evening planet in Taurus, compromised by twilight mid-month onwards.

Saturn
Poorly placed morning planet forming a compact triangle with Venus and Neptune early in May.

Uranus
Not visible this month. Solar conjunction on 17 May.

Neptune
Not visible this month.

May's key Moon phases

FIRST QUARTER
4 May

FULL MOON
12 May

LAST QUARTER
20 May

NEW MOON
27 May

VUL
SGE
CRB
BOO
VIR
SCO
HERCULES
SERPENS CAPUT
AQUILA
OPHIUCHUS
SCUTUM
SERPENS CAUDA
SAGITTARIUS
LIBRA
Sarin
Korneophoros
NGC 6210
Rasalgethi
Rasalhague
Cebalrai
Poniatowski's Bull
IC 4665
Collinder 350
NGC 6633
NGC 6709
NGC 6755
IC 4756
Alya
Marfik
Unukalhai
Yed Prior
Yed Posterior
Han
Sabik
Zubeneshamali
M14
NGC 6366
M12
M10
M107
M5
NGC 6356
M9
Gum 84-85
NGC 6604
M16
NGC 6605
M17
M18
M11
M26
NGC 6664
NGC 6712
5°
N
E
W
S
109
110
111
102
95
93
72
71
73
74
66
67
68
64
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37
48
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τ6
τ7
τ8
R

Constellation of the season

SUMMER: Serpens

Serpens is split into two. It represents the snake held by the healer Asclepius, who is shown by the large summer constellation of Ophiuchus, the Serpent Bearer. Legend claims Asclepius killed a snake, but saw it being resurrected by another snake after the application of a herb. Learning from the experience, Asclepius then worked out how to revive humans using the same technique. This angered Hades, God of the Underworld, as it robbed him of the dead. Hades complained to his brother Zeus, who also worried Asclepius would pass the skill of resurrection to other humans, resulting in immortality. Zeus blasted the healer with lightning bolts, causing Asclepius to be elevated into the heavens as Ophiuchus, his hands wide open, wrapped with snakes. Today, a symbol of a snake entwined around Asclepius's staff is often the logo used by medical facilities.

In the night sky, Ophiuchus holds Serpens so the serpent is divided into two parts. The part to the east is Serpens Cauda, the Serpent's Tail, the part to the west is Serpens Caput, the Serpent's Head. Serpens as a whole is accepted as one of the 88 IAU recognised constellations, yet on star charts it's drawn as two distinct areas representing Serpens Caput and Serpens Cauda. Some charts draw a dotted line between sections as shown here.

Serpent's neck

Serpens Caput to the west is more distinctive, appearing like a zig-zag of stars with mag. +2.6 Unukalhai (Alpha (α) Serpentis) in the middle. Unukalhai is a red-giant star, its name literally meaning 'the serpent's neck'. At the top of the zig-zag is a small group of indistinct stars (Beta (β), Gamma (γ), Kappa (κ) and Iota (ι) Serpentis), which represents the serpent's actual head, the rest of the zig-zag to the south describing its 'neck'. To locate the head, find the distinctive semi-circular constellation of Corona Borealis, the Northern Crown and the Serpen's head pattern lies immediately south of it.

Nestled in the extreme southwest corner of Serpens Caput is mag. +5.0 5 Serpentis. 22 arcminutes northwest of this star lies the rich and impressive mag. +5.6 globular cluster M5; a strong contender for the title of the best globular cluster in the northern half of the sky, lying just 2° north of the celestial equator.

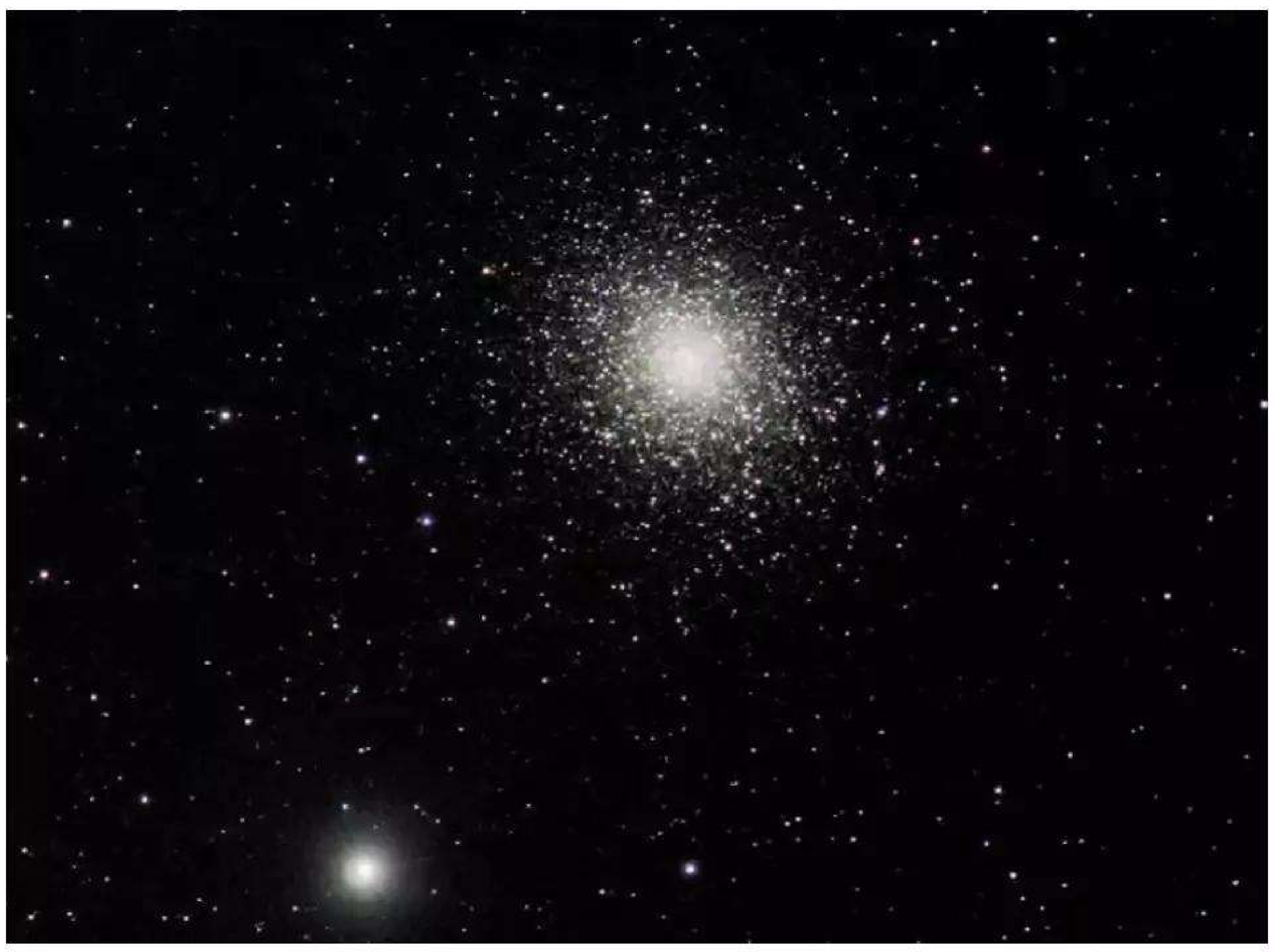
Returning to the head pattern, R Serpentis, a Mira-type variable, sits just south of the mid-point between Beta and Gamma Serpentis. This has a large brightness range, just visible to the naked eye when at peak brightness around fifth magnitude, it dips to around fourteenth magnitude when at minimum. The period of variability is 356.41 days.

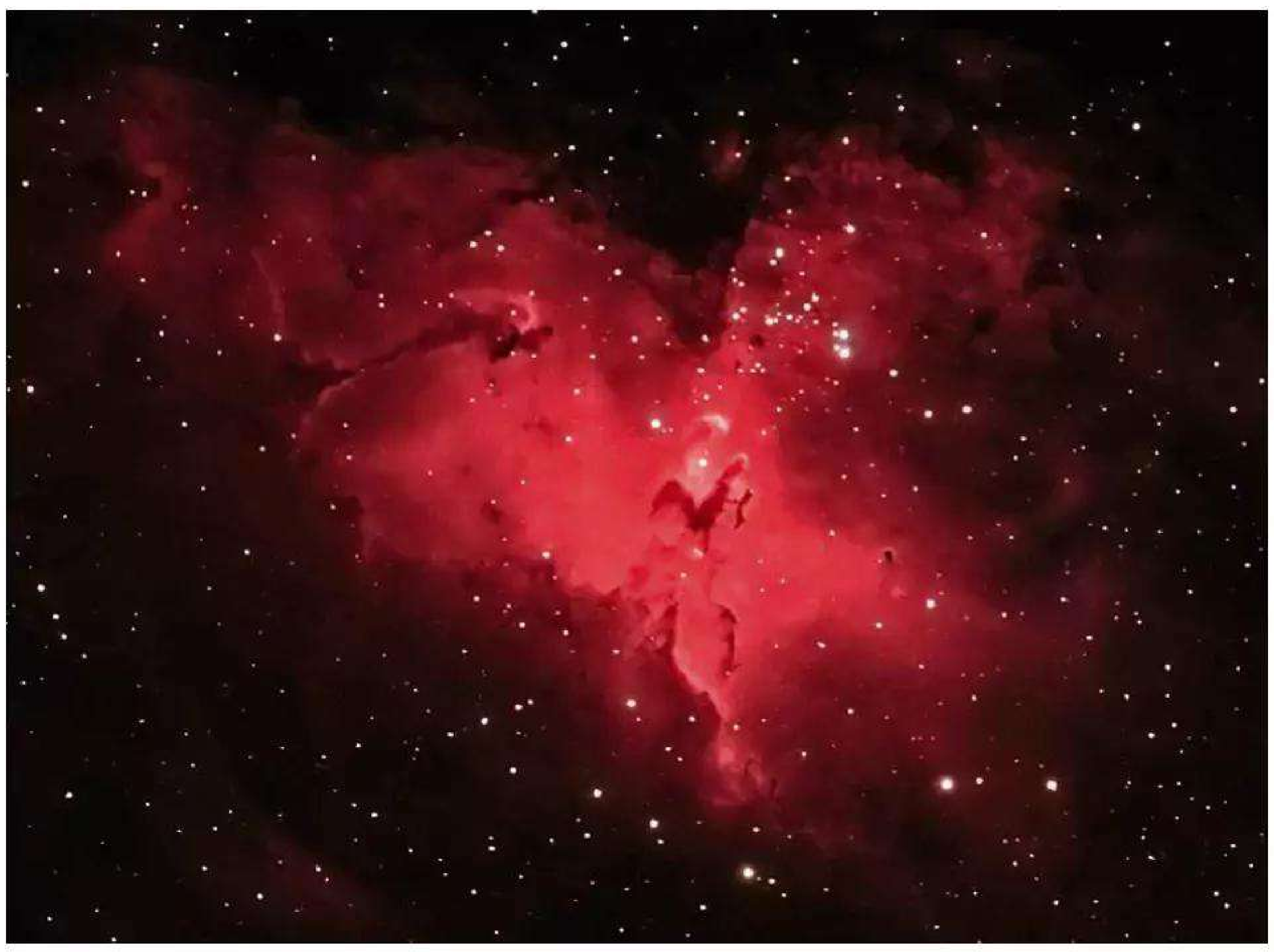
As you move from the head down the creature's neck, the first noticeable star is mag. +3.8 Delta (δ) Serpentis, a lovely binary star. Both components are F-type subgiants with magnitudes of +4.3 and +5.2. Separated by 4-arcseconds, the brighter star appears yellow-white, the dimmer one a fraction redder.

Switching to the east of Ophiuchus brings us to Serpens Cauda, the Serpent's Tail, often depicted joined to Ophiuchus's northeast shoulder, linked between mag. +3.2 Eta (η) Serpentis and 70 Ophiuchi. From Eta, Serpens Cauda is typically shown connecting to Nu (ν) Ophiuchi and then on to Omicron (ο) Serpentis, as if the serpent bearer is holding the serpent.

▼ Left: Globular cluster M5 is conveniently located near fifth magnitude 5 Serpentis, the bright star at the bottom of this image

Right: Glorious in long exposude photographs, the nebulosity in M16 is tricky to see through smaller telescopes





ALL PICTURES: PETE LAWRENCE

June

Catch interesting planetary displays and perhaps a noctilucent cloud display

All month Keep watch for noctilucent clouds as the season progresses

1 June Venus at greatest western elongation (morning)

17 June Mars and Regulus separated by just 0.7° (morning)

19 June Conjunction of Saturn, the last quarter Moon and Neptune (morning)

21 June Northern Hemisphere's summer solstice

◁ **Star trails**

Varsha Sharma, Kausani, Uttarakhand, India, March 2018

June at a glance

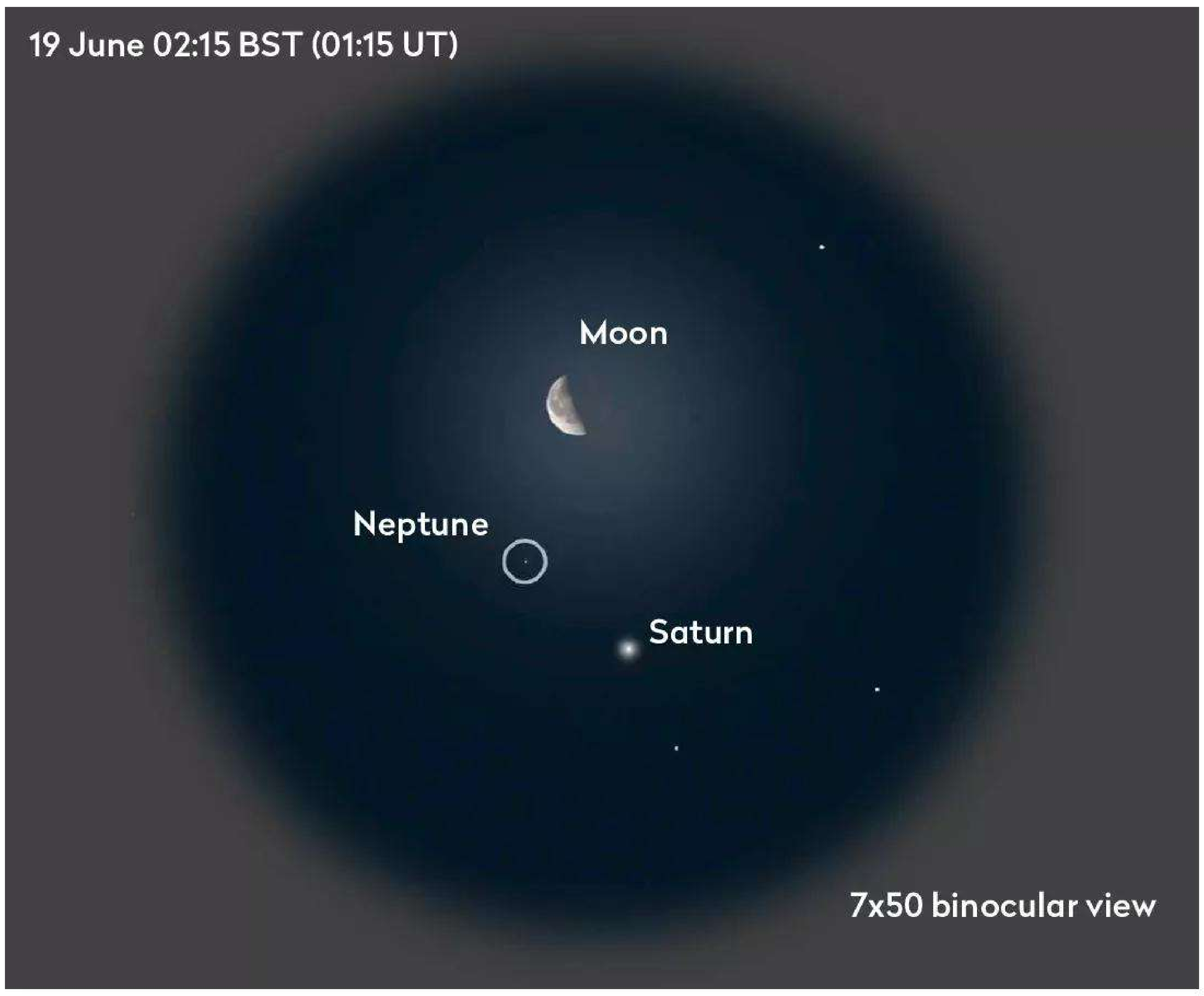
▲ Noctilucent cloud season gets into full swing this month

June is a challenging month for UK astronomy, the solstice on 21 June rendering the nights short and without true darkness. In a way, this can make identification of the major constellations a little easier with fewer faint stars to confusion the view. It's also the first full month where **noctilucent cloud (NLC) displays** may be witnessed.

NLCs are an atmospheric phenomenon linked with meteor dust, the tiny particulates left behind when a meteoroid vaporises in Earth's atmosphere to form a meteor trail. From late May to early August the temperature of the mesosphere drops. Water vapour present at a height around 82km up, becomes super-cooled and, on contact with a particle of meteor dust, forms a minute ice crystal. If enough crystals are created, ice-sheet clouds can form. At such a high altitude, roughly seven times higher than the highest regular or tropospheric clouds, when the Sun is below the horizon at ground level, sunlight is still reflecting off the NLCs high in the sky, so they shine in the deep twilight. Noctilucent means 'night shining'.

NLCs are typically seen low above the northwest horizon 90-120 minutes after sunset or a similar time before sunrise low above the northeast horizon. They typically have a beautiful blue white colour and often show delicate herringbone structures.

▼ Early risers on 19 June get to see the last quarter Moon naer Saturn with a tricky Neptune close by too



PETE LAWRENCE X 3, ISTOCK X 7, NASA X 4

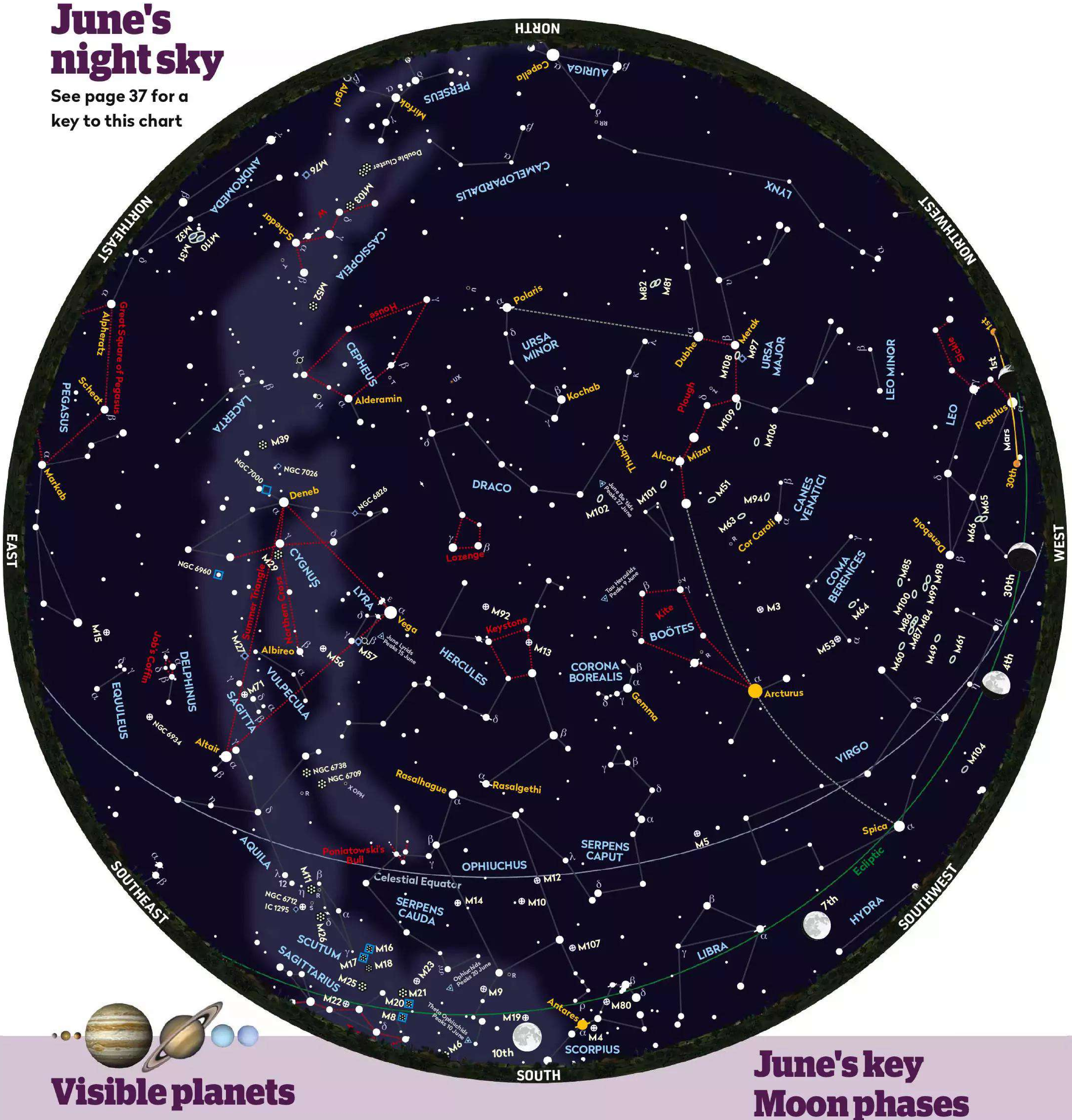
The stars in the June sky would be beautiful if it weren't for the lack of true darkness. The red supergiant **Antares** (Alpha (α) Scorpii) can be seen hugging the southern horizon. Marking the heart of Scorpius, the Scorpion, it shines with a distinctive orange colour which is said to resemble the hue of planet Mars; the name Antares literally means 'rival of Mars'. West of Antares are the distinctive stars marking the scorpion's claws and further west still the constellation of Libra, the Scales. The two main stars of Libra are **Zubeneschemali** (Beta (β) Scorpii) and **Zubenelgenubi** (Alpha (α) Scorpii), names which mean 'northern claw' and 'southern claw' respectively, this being because they once were part of Scorpius.

North of Antares is the large void of **Ophiuchus, the Serpent Bearer**, best described as looking like a tall house with a pointed roof and dangling legs. Ophiuchus is carrying a snake in the form of **Serpens, the Serpent**, the only constellation sub-divided into two; Serpens Cauda the Serpent's Tail to the east and Serpens Caput the Serpent's head to the west.

Serpens Caput contains the beautiful globular cluster **M5** immediately adjacent to 5 Serpentis. Not to be outdone, Serpens Cauda contains (albeit only just) the **Eagle Nebula M16**. Made famous by the Hubble and then JWST images, and known as the **Pillars of Creation**, the nebula is hard to see through small telescopes and you're more likely to see just the embedded star cluster. Larger scopes show the faint glow of the nebula gas, with imaging required to reveal it in its full glory.

June's night sky

See page 37 for a key to this chart


NORTH
NORTHWEST
WEST
SOUTHWEST
SOUTH
SOUTHEAST
EAST
NORTHEAST
AURIGA
Capella
PERSEUS
Mirfak
Algol
CAMELOPARDALIS
LYNX
Double Cluster
M76
M103
ANDROMEDA
M110
M31
M32
Schedar
W
CASSIOPEIA
M52
Polaris
URSA MINOR
Kochab
M82
M81
Dubhe
Merak
M97
M108
URSA MAJOR
Plough
M109
M106
LEO MINOR
LEO
Regulus
Sickle
1st
Mars
30th
House
CEPHEUS
Alderamin
Great Square of Pegasus
Alpheratz
Scheat
PEGASUS
Markab
LACERTA
M39
NGC 7000
NGC 7026
Deneb
NGC 6826
DRACO
Thuban
Alcor
Mizar
M101
M102
June Boötids Peaks 27 June
M51
M94
M63
Cor Caroli
CANES VENATICI
Denebola
M66
M65
Lazenge
CYGNUS
M29
NGC 6960
Summer Triangle
Northern Cross
LYRA
Vega
M92
Keystone
M13
HERCULES
Tau Herculids Peaks 9 June
Kite
BOÖTES
M3
COMA BERENICES
M64
M53
M85
M100
M98
M99
M86
M87
M84
M60
M49
M61
4th
M15
Job's Coffin
DELPHINUS
EQUULEUS
M27
Albireo
M56
M57
June Lyrids Peaks 15 June
VULPECULA
M71
SAGITTA
NGC 6934
Altair
CORONA BOREALIS
Gemma
Arcturus
VIRGO
M104
NGC 6738
NGC 6709
X OPH
Rasalhague
Rasalgethi
Spica
Ecliptic
AQUILA
Poniatowski's Bull
Celestial Equator
OPHIUCHUS
SERPENS CAPUT
M5
M12
M11
NGC 6712
IC 1295
M26
M14
M10
SERPENS CAUDA
SCUTUM
M16
M17
M18
M107
LIBRA
HYDRA
7th
SAGITTARIUS
M25
M23
Ophiuchids Peaks 20 June
M9
M22
M21
M20
M8
Theta Ophiuchids Peaks 10 June
M6
M19
10th
Antares
M80
M4
SCORPIUS

Visible planets

Where to spot the planets this month

Mercury
Best placed at end of June in evening sky. 2%-lit waxing Moon nearby 26 June.

Venus
Morning planet. Greatest western elongation 1 June.

Mars
Low altitude morning planet. Conjunction with similar brightness Regulus 16 June.

Jupiter
Evening planet, near the Sun. Solar conjunction 24 June, thereafter a morning planet.

Saturn
Another poorly located morning planet, currently close to Neptune.

Uranus
Not visible this month.

Neptune
Difficult morning planet. Possibly visible on 19 June (02:15 BST (01:15 UT)) when near Saturn and 47%-lit waning Moon.

June's key Moon phases

FIRST QUARTER
3 June

FULL MOON
11 June

LAST QUARTER
18 June

NEW MOON
25 June

July

Mercury puts on a show at twilight, and Saturn and Neptune come together

All month Possible noctilucent cloud displays

2 July Lunar X & V clair-obscur effects visible on the Moon (around 23:40 BST (22:40 UT))

4 July Mercury at greatest eastern elongation (evening twilight)

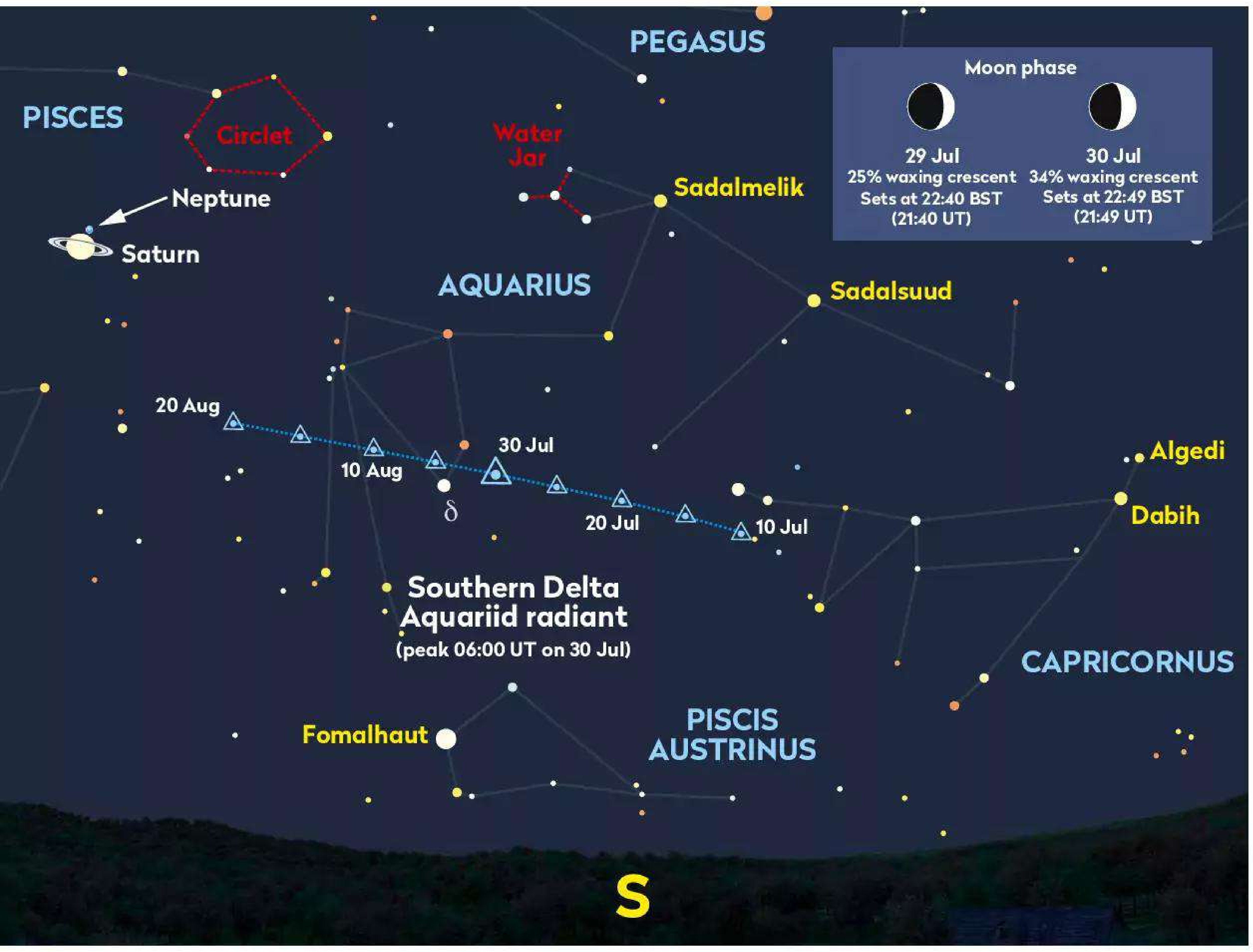
16 July Saturn and Neptune less than a degree apart (01:40 BST (00:40 UT))

29/30 July Peak of the Delta Aquariid meteor shower

◁ **The Dolphin Head Nebula**

Egidio Vergani, processed from data captured by ChileScope, Atacama Desert, Chile, 1 March 2024

July at a glance



▲ The Southern Delta Aquariid meteor shower has no Moon interference, with peak ZHR around 25 meteors per hour

From the UK, July's skies should be similarly compromised to those of June, being so close to the Northern Hemisphere's summer solstice. However, starting the month just over a week from the solstice means that the end of July does return to an albeit brief level of darkness. This is an ideal time to start trying to spot the brightest part of the **Milky Way**, as it snakes its way down from the overhead point towards the southwest horizon.

As it goes, it flows along the eastern edge of the giant **Summer Triangle** asterism, a large down pointing triangle formed from the three bright stars Deneb in Cygnus, Vega in Lyra and Altair in Aquila, all being the principal alpha (α) stars of their respective constellations.

As the Milky Way passes Deneb it appears to split in two, a dark rift dividing the two resulting sections. Just south of Deneb the split is fairly wide leading to a region known as the **Northern Coalsack**. The main split passing down through Cygnus is known as the **Cygnus Rift**.

Cygnus itself is a large constellation representing a swan. As we see it from the UK, the bird is flying down the sky, Deneb marking the tail and the beautiful telescopic double star Albireo (Beta (β) Cygni) representing the head, or rather beak. With the Milky Way present in this region there are lots of deep sky objects on show, but strangely among the many clusters and patches of nebulosity, there are only two Messier objects; **M29** and **M39**. The core shape of Cygnus is that of a large cross, the pattern identified by the asterism known as the Northern Cross.

Vega's host is **Lyra, the Lyre**, a harp-like musical instrument with a stringed section represented by a squashed diamond pattern of stars southeast of Vega.

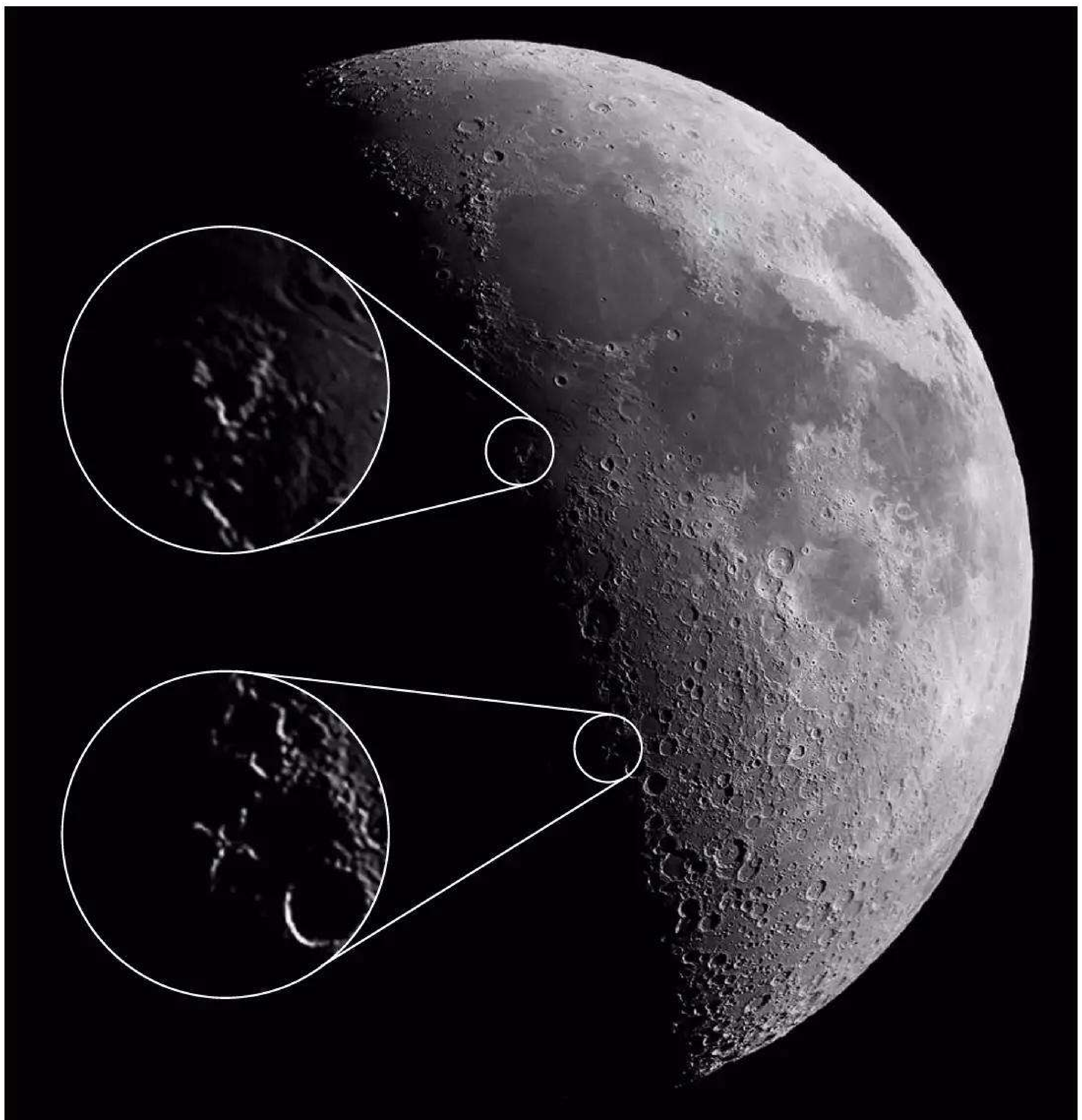
The beautiful **Ring Nebula M57** sits a fraction south of the mid-point of the line between the lower two stars in this pattern, slightly offset towards Sheliak (Beta (β) Lyrae) to the west. Vega forms a small equilateral triangle with Zeta (ζ) and Epsilon (ε) Lyrae. Take a close look at **Epsilon** to the north and, assuming you have good eyesight, you should be able to split it in two. Point a telescope at the pair and with good conditions and a decent magnification you'll see they each split into two again, Epsilon Lyrae being unsurprisingly known as the **Double-Double**.

The third and southernmost star in the Summer Triangle is bright **Altair**, easily identified by the two dimmer stars that flank it; Tarazed (Gamma (γ) Aquliae) to the north-northwest and Alshain (Beta (β) Aquilae) to the south-southeast.

Aquila is often described as having a cross like shape but, unlike the distinctive and readily identifiable cruciform pattern of the Northern Cross, Aquila is more like an irregular X. If you imagine Altair as the upper-left corner of this shape, the lower-right position is marked by a distinctive star curve; Althalimain (Lambda (λ) Aquilae), 12 Aquilae and Eta (η) Scuti, the latter belonging to the small diamond-shaped constellation of Scutum, the Shield.

The curve arcs into a bright knot of Milky Way, known as the **Scutum Star Cloud**, passing the rich Wild Duck Cluster, M11 as you go. Through a telescope this is an unbelievably rich cluster, criss-crossed by dark dust lanes which gives the appearance that something has come along and broken it.

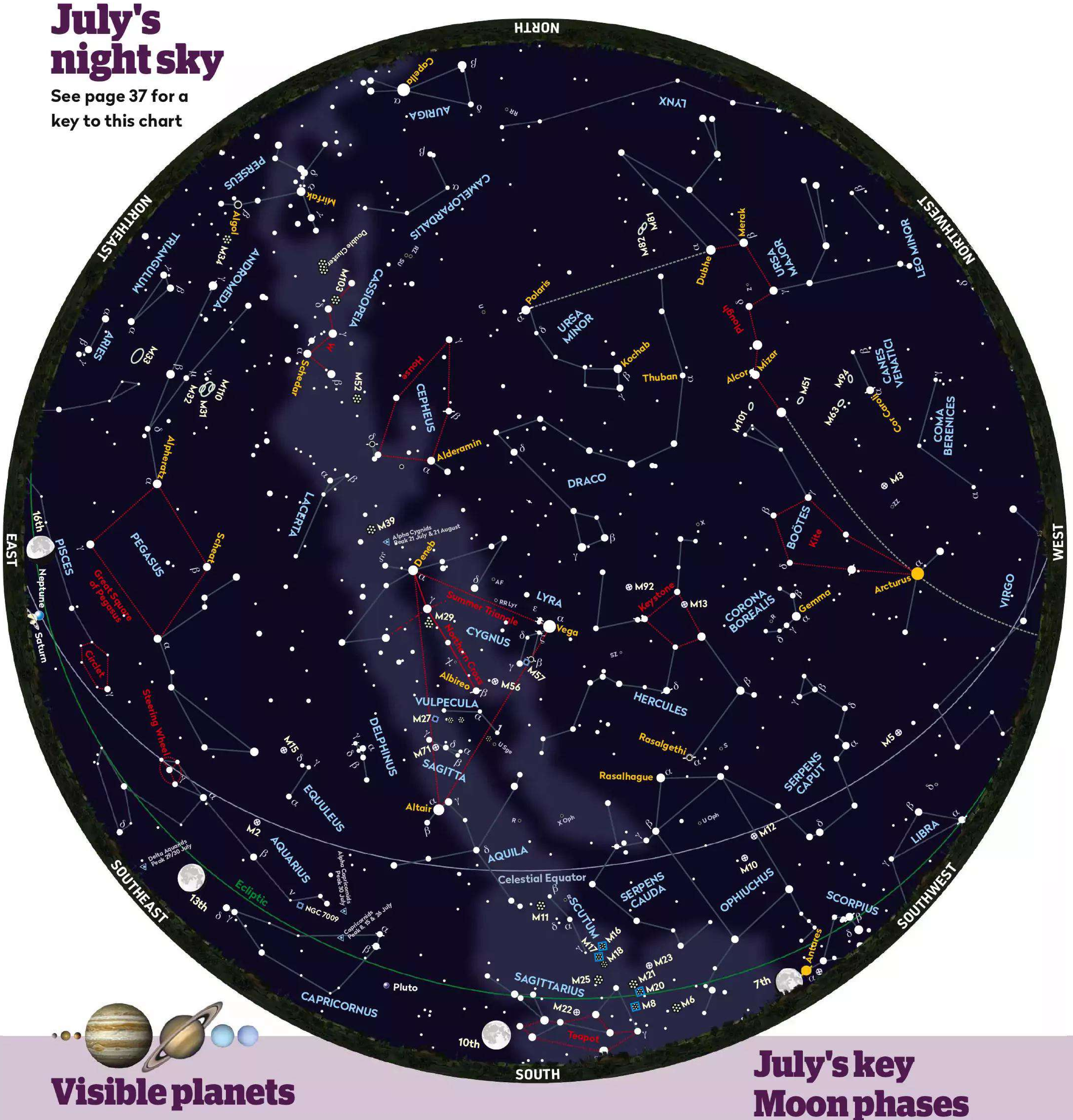
▼ The clair-obscur effects of the Lunar X and V — are visible before midnight on 2 July



PETE LAWRENCE X 3, ISTOCK X 7, NASA X 4

July's night sky

See page 37 for a key to this chart


NORTH
NORTHEAST
NORTHWEST
EAST
WEST
SOUTHEAST
SOUTHWEST
SOUTH
Capella
AURIGA
LYNX
PERSEUS
Mirfak
Algol
M34
TRIANGULUM
ANDROMEDA
Double Cluster
CAMELOPARDALIS
M103
CASSIOPEIA
W
Schedar
M52
ARIES
M33
M110
M32
M31
Alpheratz
Polaris
URSA MINOR
Kochab
Thuban
M82
M81
Dubhe
Merak
URSA MAJOR
Plough
Alcor
Mizar
LEO MINOR
M51
M94
M63
M101
CANES VENATICI
Cor Caroli
COMA BERENICES
House
CEPHEUS
Alderamin
DRACO
M3
LACERTA
M39
Alpha Cygnids Peak 21 July & 21 August
Deneb
PEGASUS
Scheat
Great Square of Pegasus
16th
PISCES
Neptune
Saturn
Circlet
BOÖTES
Kite
Arcturus
VIRGO
M92
Keystone
M13
CORONA BOREALIS
Gemma
Summer Triangle
LYRA
Vega
M29
CYGNUS
Northern Cross
M57
M56
Albireo
HERCULES
VULPECULA
M27
DELPHINUS
M71
SAGITTA
Steering Wheel
M15
Rasalgethi
Rasalhague
SERPENS CAPUT
M5
EQUULEUS
Altair
M2
AQUARIUS
Delta Aquariids Peak 29/30 July
13th
Ecliptic
NGC 7009
Alpha Capricornids Peak 30 July
Capricornids Peak 8, 15 & 26 July
AQUILA
Celestial Equator
M11
SCUTUM
SERPENS CAUDA
M12
M10
OPHIUCHUS
LIBRA
SCORPIUS
M16
M17
M18
M23
M25
M21
M20
M8
M6
M22
SAGITTARIUS
Teapot
Antares
7th
Pluto
CAPRICORNUS
10th

Visible planets

Where to spot the planets this month

Mercury
Greatest eastern elongation (25.9°) on 4 July, poorly located in evening sky.

Venus
In conjunction with Uranus 4 July and near M35 on 31 July.

Mars
Poor position evening planet.

Jupiter
May be visible low above northeast horizon from mid-July in the dawn twilight.

Saturn
Improving morning planet, reaching 34° altitude under relatively dark twilight on 31 July.

Uranus
Low conjunction with Venus on 4 July. Reaching 16° altitude at the end of the month.

Neptune
Very near Saturn. Reaches 30° altitude under darkness by the end of the month.

July's key Moon phases

FIRST QUARTER
2 July

FULL MOON
10 July

LAST QUARTER
18 July

NEW MOON
24 July

August

There's late summer planetary action and moon events on Saturn and Jupiter this month

11 August Titan eclipsed by Saturn's shadow

12 August Venus 0.9° from Jupiter (morning)

20 August Impressive display of planets and the waning crescent Moon (morning)

27 August Titan eclipsed by Saturn's shadow

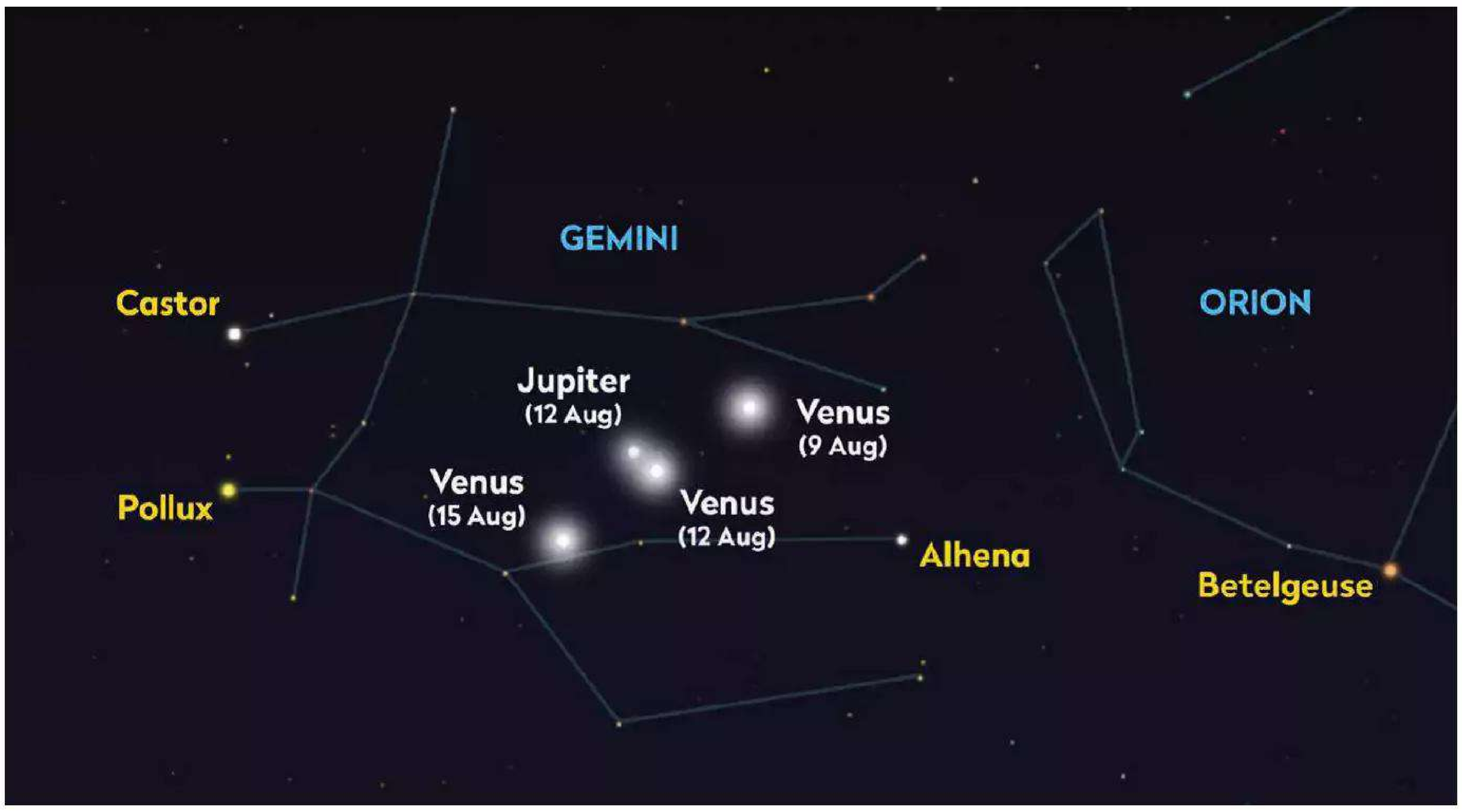
31 August Ganymede's shadow transits Jupiter (03:28-06:37 BST (02:28-05:37 UT))

◁ **Star trails**

Jason Mead, Nash Point, south Wales, 4 May 2024

August at a glance

Nights get longer and darker during August, a month known for its meteor activity. The highlight is the **Perseid shower**, which is predicted to peak at 21:00 BST (20:00 UT) on 12 August. Several minor meteor showers also reach peak activity in the days around this period, but viewing could be tricky with a bright Moon in the sky.


GEMINI
ORION
Castor
Pollux
Jupiter
(12 Aug)
Venus
(9 Aug)
Venus
(15 Aug)
Venus
(12 Aug)
Alhena
Betelgeuse

▲ Jupiter and Venus appear 0.9° apart on 12 August, best seen from 03:30 BST (02:30 UT) low above the east-northeast horizon

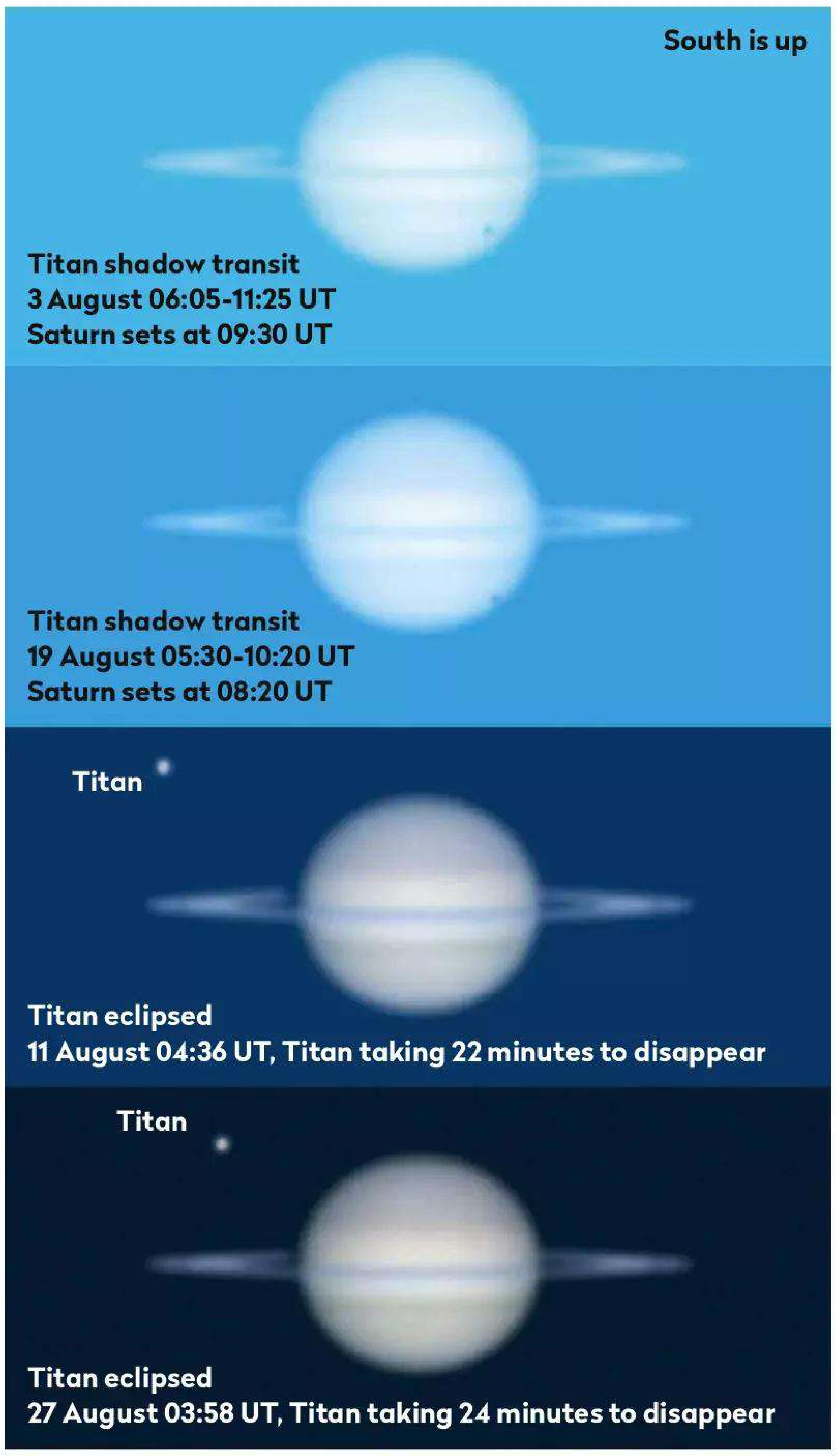
The planets are slowly improving after the solstice, **Saturn** and **Neptune** both able to reach their peak altitudes, around 35° up, under dark sky conditions after 17 August. They are synced because they currently appear really close to one another, a situation which will persist for a few months.

Through the telescope Saturn's rings currently appear very narrow, good news if you've not seen any Titan interactions with Saturn yet, as the narrow tilt will allow us to follow such events through to February 2026. There's a **Titan shadow transit** on 3 August from 07:05 BST (06:05 UT) until Saturn sets under bright sky conditions. Another marginally more favourable shadow transit starts at 06:30 BST (05:30 UT) on 19 August. In addition there are a couple of opportunities to see Titan eclipsed by Saturn's shadow; 05:36 BST (04:36 UT) on 11 August and 04:58 BST (03:58 UT) on 27 August.

Not to be left out, **Jupiter** has some less common moon-planet interactions on view, with two daylight **Ganymede shadow transits** on 2 August (11:36-14:38 BST (10:36-13:38 UT)) and 9 August (15:37-18:37 BST (14:37-17:37 UT)). It's perfectly possible to observe Jupiter under daylight, assuming you can find it, although the planet does look faint with low contrast. On 12 August (14:07-16:39 BST (13:07-15:39 UT)) Jupiter daylight location skills come into their own as Callisto's shadow performs a rare transit of the planet, an event repeated on 29 August (08:03-10:51 BST (07:03-09:51 UT). The second event may be easier to see as Jupiter can be initially located in the dawn twilight when visible to the naked eye. Ganymede's shadow transits the planet again on 31 August, this time visible under darker sky conditions between 03:38-06:36 BST (02:38-05:36 UT).

Lengthening nights in August effectively halt the demise of the summer Milky Way. Despite its inevitable daily western drift, earlier darkness helps keep this impressive area of sky visible in the same general position relative to the horizon during August. Look low to the south and see whether you can spot the **Teapot asterism** in Sagittarius, the Archer.

The handle to the east of the Teapot is perhaps the easiest section to spot. Binoculars will reveal many interesting deep-sky objects where the steam can be imagined to rise out of the spout. These include the superb **Lagoon Nebula M8** and the fainter yet photographically beautiful **Trifid Nebula M20**, further to the north. Heading up towards diamond-shaped Scutum, the Shield look out for **M17**, a bright emission nebula that seems to have garnered far too many informal names, being known as the Swan, Lobster, Horseshoe, Omega Nebula, amongst others. The **Eagle Nebula M16** sits just north of M17, but the nebulosity here is tricky to see with smaller scopes. What's most likely to be seen is the cluster of stars which formed out of the nebula gas.

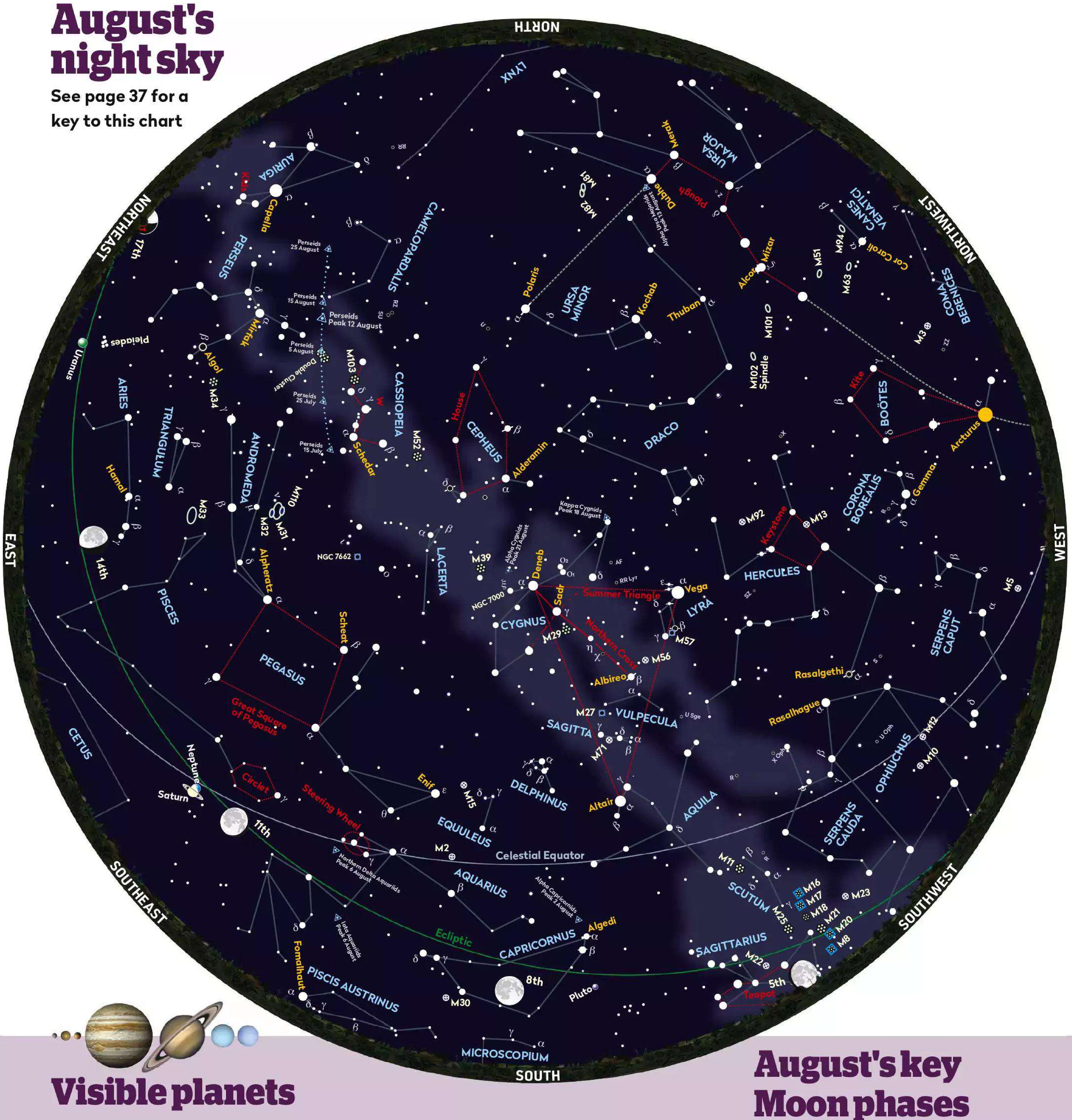

South is up
Titan shadow transit
3 August 06:05-11:25 UT
Saturn sets at 09:30 UT
Titan shadow transit
19 August 05:30-10:20 UT
Saturn sets at 08:20 UT
Titan
Titan eclipsed
11 August 04:36 UT, Titan taking 22 minutes to disappear
Titan
Titan eclipsed
27 August 03:58 UT, Titan taking 24 minutes to disappear

◀ Two tricky daylight Titan shadow transits and two deep twilight views of Titan being eclipsed by Saturn's shadow occur this month

PETE LAWRENCE X 3, ISTOCK X 7, NASA X 4

August's night sky

See page 37 for a key to this chart


NORTH
NORTHEAST
NORTHWEST
EAST
WEST
SOUTHEAST
SOUTHWEST
SOUTH
LYNX
URSA MAJOR
Merak
Dubhe
Plough
M81
M82
CANES VENATICI
Cor Caroli
M94
M63
M51
Alcor
Mizar
COMA BERENICES
M3
AURIGA
Kids
Capella
CAMELOPARDALIS
PERSEUS
Perseids 25 August
Perseids 15 August
Perseids Peak 12 August
Perseids 5 August
Perseids 25 July
Perseids 15 July
Mirfak
Algol
M34
Pleiades
Uranus
17th
Double Cluster
M103
CASSIOPEIA
W
Schedar
M52
Polaris
URSA MINOR
Kochab
Thuban
M101
M102 Spindle
DRACO
Kite
BOÖTES
Arcturus
House
CEPHEUS
Alderamin
ARIES
TRIANGULUM
ANDROMEDA
Hamal
M33
M110
M32
M31
CORONA BOREALIS
Gemma
M92
Keystone
M13
HERCULES
Kappa Cygnids Peak 18 August
Alpha Cygnids Peak 21 August
LACERTA
M39
NGC 7662
NGC 7000
Deneb
Sadr
Summer Triangle
Vega
LYRA
RR Lyr
14th
Alpheratz
PISCES
CYGNUS
M29
Northern Cross
M56
M57
SERPENS CAPUT
M5
Rasalgethi
Scheat
PEGASUS
Great Square of Pegasus
Albireo
VULPECULA
M27
U Sge
SAGITTA
M71
Rasalhague
OPHIUCHUS
M12
M10
CETUS
Neptune
Saturn
Circlet
Steering Wheel
Enif
M15
DELPHINUS
Altair
AQUILA
SERPENS CAUDA
11th
EQUULEUS
M2
Celestial Equator
Northern Delta Aquariids Peak 6 August
AQUARIUS
M11
SCUTUM
M16
M17
M18
M23
M25
M21
M20
M8
Alpha Capricornids Peak 2 August
Algedi
CAPRICORNUS
Ecliptic
SAGITTARIUS
M22
Iota Aquariids Peak 6 August
Fomalhaut
PISCIS AUSTRINUS
M30
8th
Pluto
5th
Teapot
MICROSCOPIUM

Visible planets

Where to spot the planets this month

Mercury
Morning planet, difficult to see at the start of the month, easier to spot after 19 Aug.

Venus
Morning planet, near M35 at the start of Aug. Jupiter conjunction 12 Aug. Near M44 31 Aug.

Mars
Poorly located in bright evening twilight.

Jupiter
52 arcseconds from Venus 12 Aug at 04:30 BST (03:30 UT).

Saturn
Morning planet, reaching peak altitude of 35° under darkness from 17 Aug.

Uranus
Morning planet, best end Aug when reaches 48° altitude in dark conditions.

Neptune
Morning planet near Saturn. Reaches peak altitude of 36° under darkness from 17 Aug.

August's key Moon phases

FIRST QUARTER
1 Aug

FULL MOON
9 Aug

LAST QUARTER
16 Aug

NEW MOON
23 Aug

FIRST QUARTER
31 Aug

ERIDANUS
FORNAX
SCULPTOR
CETUS
ARIES
PISCES
TAU
PEG
AQR
Menkar
Kaffaljidhma
Mira
Baten Kaitos
Alrescha
Diphda
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ξ1
ξ2
ω
ρ1
ρ2
ρ3
τ1
τ2
τ3
τ4
τ5
τ6
τ7
M77
NGC 936
NGC 908
NGC 1232
NGC 1300
NGC 1332
NGC 1395
NGC 1407
NGC 1360
NGC 488
IC 1613
NGC 246
NGC 247
NGC 253
NGC 288
NGC 157
NGC 45
PGC 143
5°
N
E
S
W

Constellation of the season

AUTUMN: Cetus

Although often described as a whale, Cetus is typically associated with the mythology of a sea monster. Cetus was sent by Poseidon to ravage the land ruled by King Cepheus and Queen Cassiopeia after the queen boasted that her daughter Andromeda was more beautiful than the sea nymphs. King Cepheus was advised that the only way to stop the destruction of his kingdom was to chain Andromeda to a coastal rock as sacrifice to Cetus. Perseus swooped in on the back of Pegasus, the Flying Horse, saving the day by showing the head of the Gorgon Medusa to Cetus, turning the monster to stone.

A cosmological mix-up

The whale reference comes from the Latin name Cetus, which means 'whale'. Constellation line-art depictions of Cetus look distinctly whale-like; a large, elongated body incorporating a rounded head and forked tail at the other end. In the sky, this outline faces west, the tail raised high to the northeast. This is completely wrong! The brightest star in the head, possibly the mouth in our erroneous description, is Diphda or Deneb Kaitos (Beta (β) Ceti). The name Deneb Kaitos means 'whale's tail' which would seem appropriate given Cetus's supposed representation. To complicate further, in 2016 the IAU approved Diphda as the official name of this star which means 'frog'.

The northeast section of Cetus contains the bright orange star Menkar (Alpha (α) Ceti), meaning 'nostril'. Clearly, the creature represented by Cetus is facing east rather than west, the misshapen pentagon of stars containing Menkar representing the head.

Tau (τ) Ceti is a star spectrally similar to our own Sun and around 78% of the Sun's mass. Lying at a distance of 12 lightyears, it's known to have at least four planets with the possibility of four more, all likely larger versions of Earth ('super Earths'), two are within the star's habitable zone. These properties and its relatively close proximity make Tau Ceti popular with science fiction writers. It's also a common target for Search for Extra Terrestrial Intelligence (SETI) projects.

Mira (Omicron (ο) Cetis), meaning 'wonderful' or 'astonishing' in Latin is a pulsating red giant star, which changes in brightness over a period of 332 days. On average, it peaks around mag. +3.4, but has been observed to go as high as mag. +2.0. The next peak is expected in early April 2025, which is unfortunate because Cetus will be lost in the Sun's glare. To locate Mira's position in the monster's neck, first identify the cord tying the two fish together in Pisces, the Fish. The faint stars of the cord consist of two parts joined at the star Alrescha (Alpha (α) Piscium), which point at Mira.

Cetus has two notable deep-sky objects — M77 and NGC 246. M77 is a barred spiral galaxy, which shines with an integrated apparent magnitude of +8.9, and is located 53 arcminutes to the east and slightly south of Delta (δ) Ceti. NGC 246 is a planetary nebula, known as the Skull Nebula. It appears 3.8-arcminutes in diameter and is bright at mag. +8.0. Its central star is an example of a hierarchical triple star system — a stable arrangement where multiple orbits barely interact.

When Diphda is due south and close to maximum altitude, look 7.2° to the south for NGC 253 the Sculptor Galaxy. While not within Cetus itself, NGC 253 (Silver Dollar Galaxy) is just over the border in Sculptor, the Sculptor, shining with an integrated magnitude of +8.0.

▼ Left: Although not strictly within Cetus, Diphda (Beta (β) Ceti) is the best navigational pointer to the beautiful Sculptor Galaxy, NGC 253

Right: The Skull Nebula, NGC 246, is a beautiful planetary nebula within the body of Cetus

ALL PICTURES: PETE LAWRENCE

September

Don't miss the plethora of lunar spectacles this month

7 September Total lunar eclipse at moonrise (evening twilight)

12 September Moon occults the Pleiades (evening)

19 September Daylight lunar occultation of Venus

20 September Titan and its shadow transit Saturn together (from 05:13 BST (04:13 UT))

21 September Saturn at opposition

◁ **Aurora borealis**

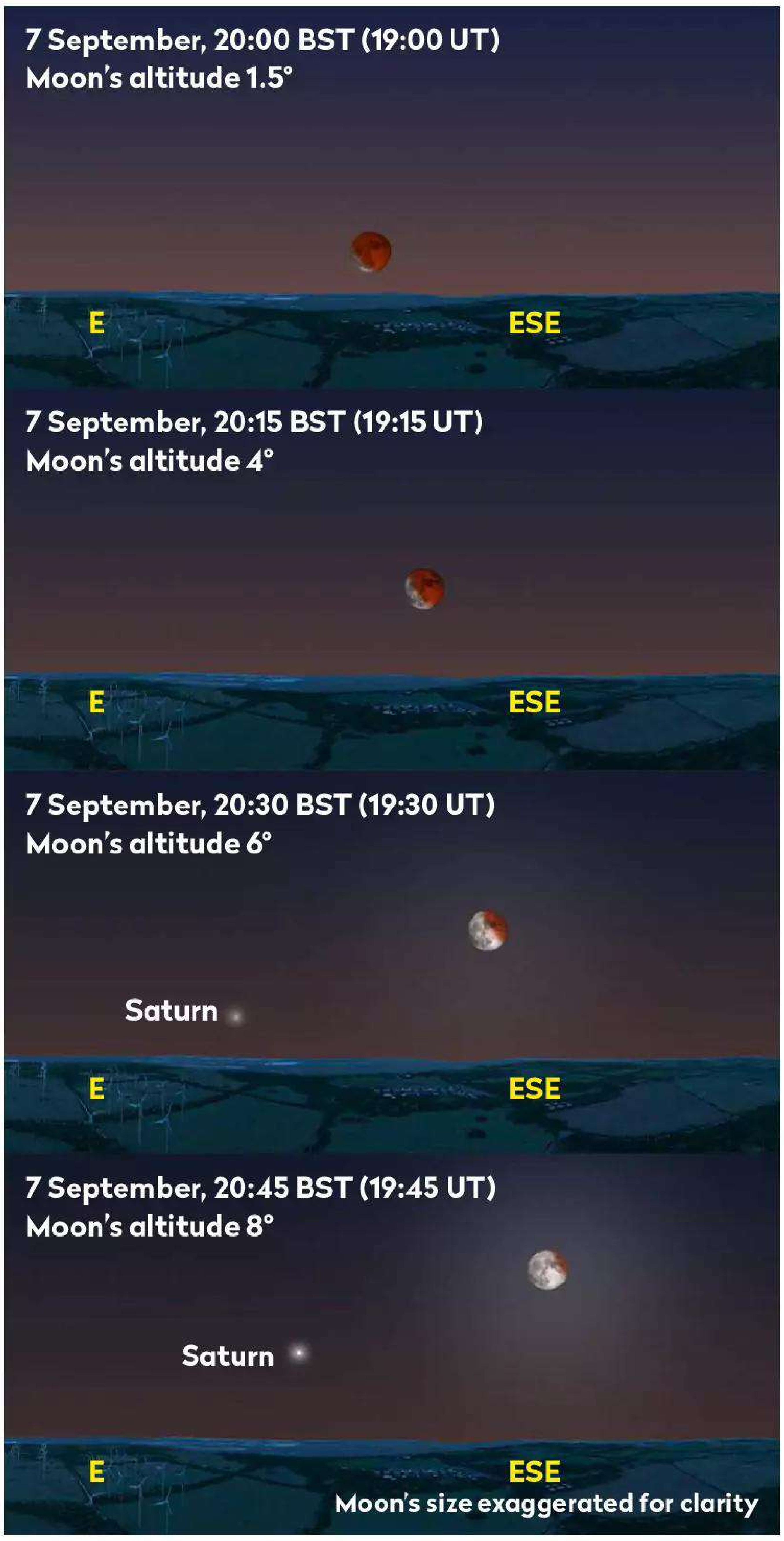
Andy Morl, Grassholme Observatory, Teesdale, County Durham, 10 May 2024

September at a glance

Night expands at its fastest rate as Earth experiences its second annual equinox on 22 September. It's a good job too, as there is a lot going on!

On 7 September the rising **Moon** will look redder than usual. A low Moon naturally looks red due to the thick atmosphere near the horizon scattering a lot of its blue light. However, as the Moon rises on 7 September, it's also totally eclipsed by Earth's shadow. Exciting though this sounds, it'll make identifying the Moon initially tricky, its dimmed light lost in atmospheric murk. Rising above the eastern horizon at 19:45 BST (18:45 UT), a few minutes after this you'll see an odd-shaped object in the sky just above the horizon, the bright portion of the Moon slowly being released from the umbral shadow, the eclipsed part hard to see at first. This now partial phase of the eclipse ends at 20:56 BST (19:56 UT), the Moon's altitude being 10°.

Five days later, on 12 September, the Moon occults the **Pleiades open cluster**. This occurs from moonrise at 21:00 BST (20:00 UT) to around midnight BST (23:00 UT). The 68%-lit waning gibbous Moon should be obvious soon after rising, but the Pleiades may require a bit of altitude before they can be seen.


7 September, 20:00 BST (19:00 UT)
Moon's altitude 1.5°
E
ESE
7 September, 20:15 BST (19:15 UT)
Moon's altitude 4°
E
ESE
7 September, 20:30 BST (19:30 UT)
Moon's altitude 6°
Saturn
E
ESE
7 September, 20:45 BST (19:45 UT)
Moon's altitude 8°
Saturn
E
ESE

Moon's size exaggerated for clarity

◀ The Moon rises at 19:45 BST (18:45 UT) totally eclipsed on 7 September. Times shown for the centre of the UK

Yet another big lunar event occurs on 19 September when the Moon occults **Venus**. Again, circumstances aren't perfect as the event occurs during daylight. With clear skies, Venus should be easy to see, but the 5%-lit waning crescent Moon harder to spot. The occultation is between 12:48 BST (11:48 UT) and 14:07 BST (13:07 UT), Venus shining at mag. -3.8, appearing 11 arcseconds across with an 88%-lit phase.

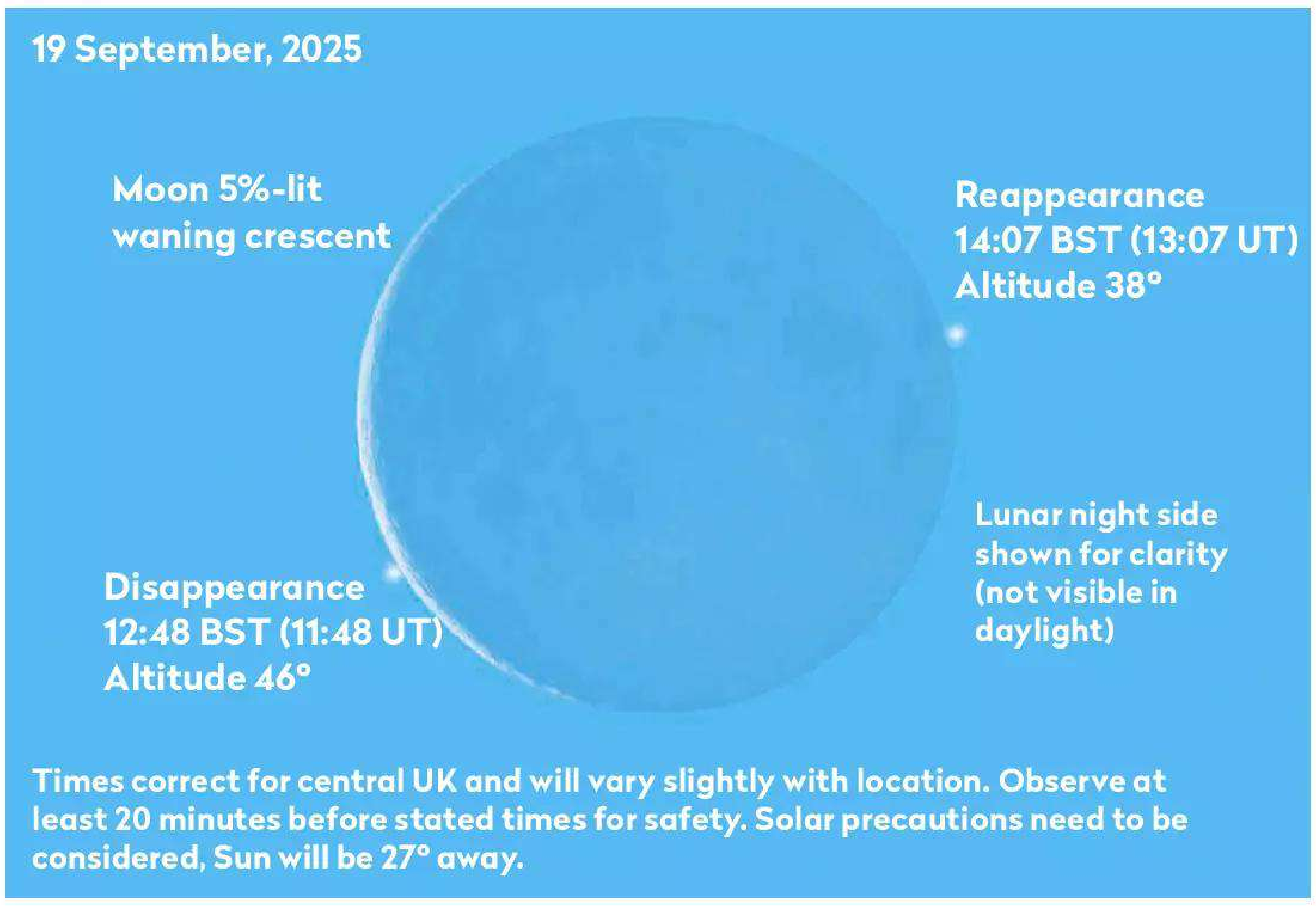
On 20 September it's a different moon grabbing attention. Between 05:13-09:27 BST (04:13-08:27 UT) Saturn's largest moon **Titan** transits the planet along with its shadow. It's not often you get to see Titan and its shadow transiting Saturn together. Being so close to Saturn's opposition on 21 September, the shadow will almost appear to touch Titan. From the UK, Saturn sets at 07:02 BST (06:02 UT) before the event concludes.

Bright **Jupiter** has a couple of interesting moon events too. On 15 September a very infrequent transit of Callisto's shadow can be seen between 02:02-05:10 BST (01:02-04:10 UT). On 27 September between 05:54-06:41 BST (04:54-05:41 UT) Io and Europa's shadows both cross Jupiter's disc at the same time in a double shadow transit event.

In the background, the stars of summer are slowly but surely drifting westward. At the southern end of the Northern Cross asterism in Cygnus, head southeast from Albireo (Beta (β) Cygni) to pass through **Vulpecula, the Fox**, with the relatively bright **Dumbbell Nebula M27**, along with the asterism known as the **Coathanger Cluster** or Collinder 399.

Keep heading southeast and you'll pass through the small distinctive shape of **Sagitta the arrow** – it does look just like an arrow. The progression of small constellations continues southeast through **Delphinus, the Dolphin**, which looks like a diamond with a small tail. Finally, there's **Equuleus, the Foal**, a small, faint quadrilateral easily overlooked. The foal leads the way towards **Pegasus, the Flying Horse** immediately east, a sure sign that autumn is on the way.

19 September, 2025



Lunar night side shown for clarity (not visible in daylight)

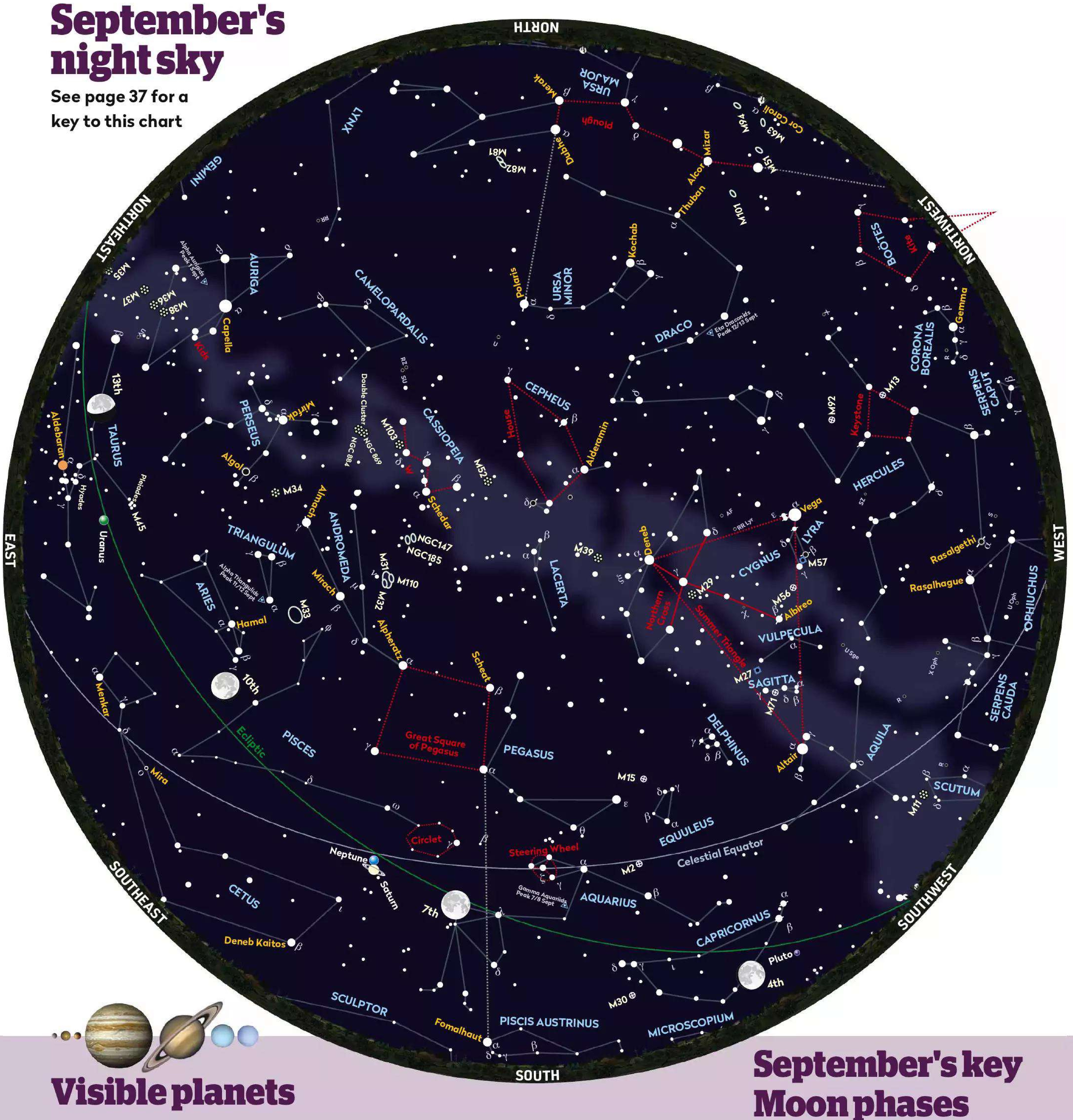
Times correct for central UK and will vary slightly with location. Observe at least 20 minutes before stated times for safety. Solar precautions need to be considered, Sun will be 27° away.

▲ A daylight lunar occultation of Venus occurs on 19 September, mag. -3.8 Venus appearing 11 arcseconds across and 88%-illuminated

PETE LAWRENCE X 3, ISTOCK X 7, NASA X 4

September's night sky

See page 37 for a key to this chart


NORTH
URSA MAJOR
Merak
Plough
Dubhe
M81
M82
Alcor
Mizar
M94
M63
Cor Caroli
M51
M101
Thuban
Kochab
URSA MINOR
Polaris
LYNX
GEMINI
RR
NORTHEAST
NORTHWEST
AURIGA
Alpha Aurigids Peak 1 Sept
M35
M37
M36
M38
Capella
Kids
CAMELOPARDALIS
DRACO
Eta Draconids Peak 12/13 Sept
BOOTES
Kite
Gemma
CORONA BOREALIS
SERPENS CAPUT
M13
Keystone
M92
HERCULES
CEPHEUS
House
Alderamin
CASSIOPEIA
M52
M103
Double Cluster
NGC 869
NGC 884
RZ
SU
PERSEUS
Mirfak
Algol
M34
Pleiades
M45
Hyades
Aldebaran
TAURUS
13th
Uranus
EAST
WEST
Almach
Schedar
ANDROMEDA
NGC147
NGC185
M31
M110
M32
TRIANGULUM
Alpha Triangulids Peak 11/12 Sept
M33
ARIES
Hamal
Mirach
Alpheratz
LACERTA
M39
Deneb
Vega
LYRA
RR Lyr
AF
CYGNUS
M57
M29
Northern Cross
Summer Triangle
M56
Albireo
VULPECULA
M27
SAGITTA
M71
Rasalgethi
Rasalhague
OPHIUCHUS
U Oph
X Oph
U Sge
SERPENS CAUDA
R
AQUILA
Altair
SCUTUM
M11
DELPHINUS
EQUULEUS
M15
Scheat
Great Square of Pegasus
PEGASUS
Menkar
10th
Ecliptic
PISCES
Mira
Circlet
Steering Wheel
Celestial Equator
M2
AQUARIUS
Gamma Aquariids Peak 7/8 Sept
Neptune
Saturn
CETUS
7th
Deneb Kaitos
CAPRICORNUS
Pluto
4th
M30
SOUTHEAST
SOUTHWEST
SCULPTOR
Fomalhaut
PISCIS AUSTRINUS
MICROSCOPIUM
SOUTH

Visible planets

Where to spot the planets this month

Mercury
Near Regulus in morning sky, lost from 3 Sept onwards. Solar conjunction on 13 Sept.

Venus
Morning planet rising 3 hours before the Sun on 1 Sept. Daylight lunar occultation on 19th Sept.

Mars
Evening planet not visible this month.

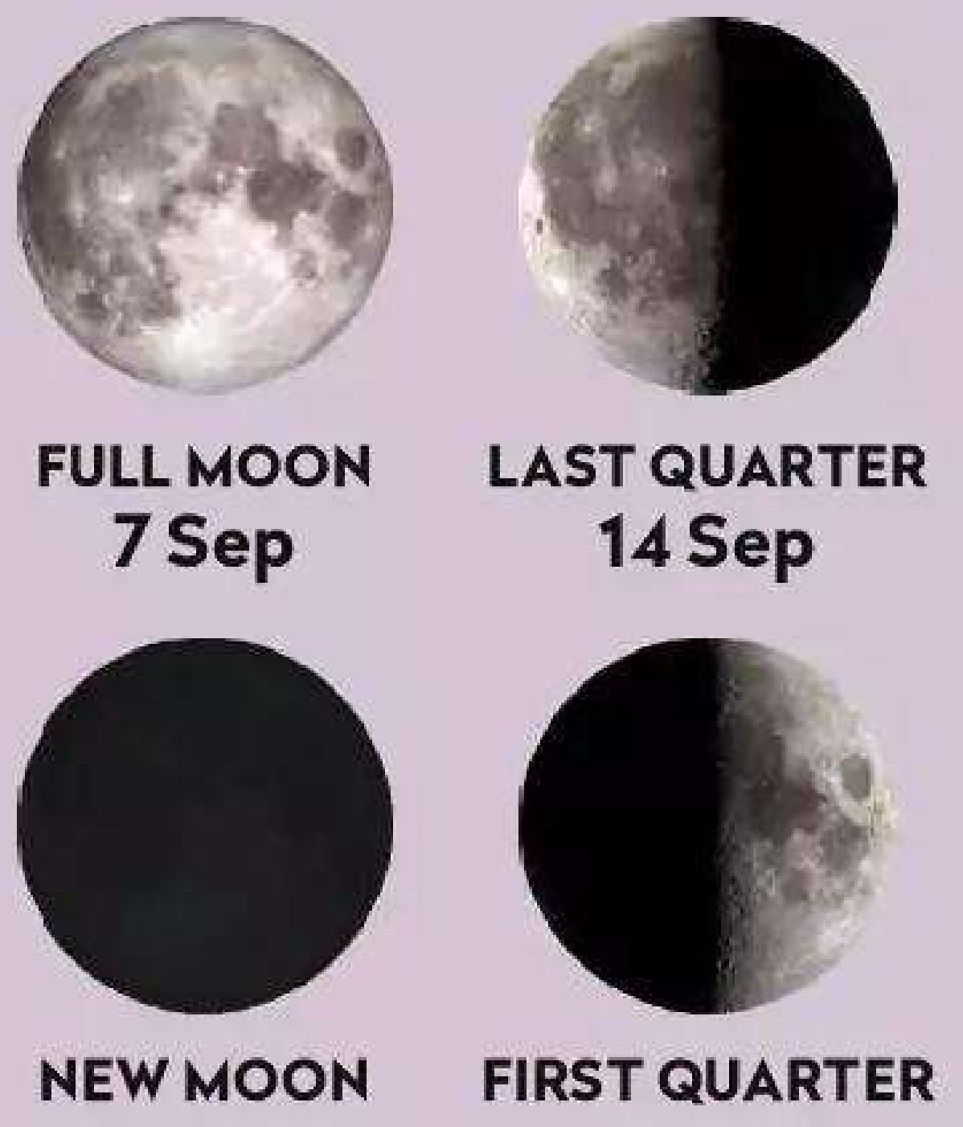
Jupiter
Improving morning planet reaching 51° altitude on 30 Sept. Near Wasat 6 & 7 Sept.

Saturn
Well presented this month, opposition on 21 Sept with a peak altitude around 34°.

Uranus
Improving morning planet, reaching peak altitude of 57° in darkness from 22 Sept on.

Neptune
Near Saturn, reaching opposition on 23 Sept.

September's key Moon phases



FULL MOON
7 Sep

LAST QUARTER
14 Sep

NEW MOON
21 Sep

FIRST QUARTER
29 Sep

October

Titan is on show this month, with a shadow transit of Saturn and then an occultation

2 October Dwarf planet Ceres at opposition (evening)

6 October Titan and its shadow transit Saturn (from 02:25 BST (01:25 UT))

7 October Harvest Moon for 2025

21 October Orionid meteor shower peak

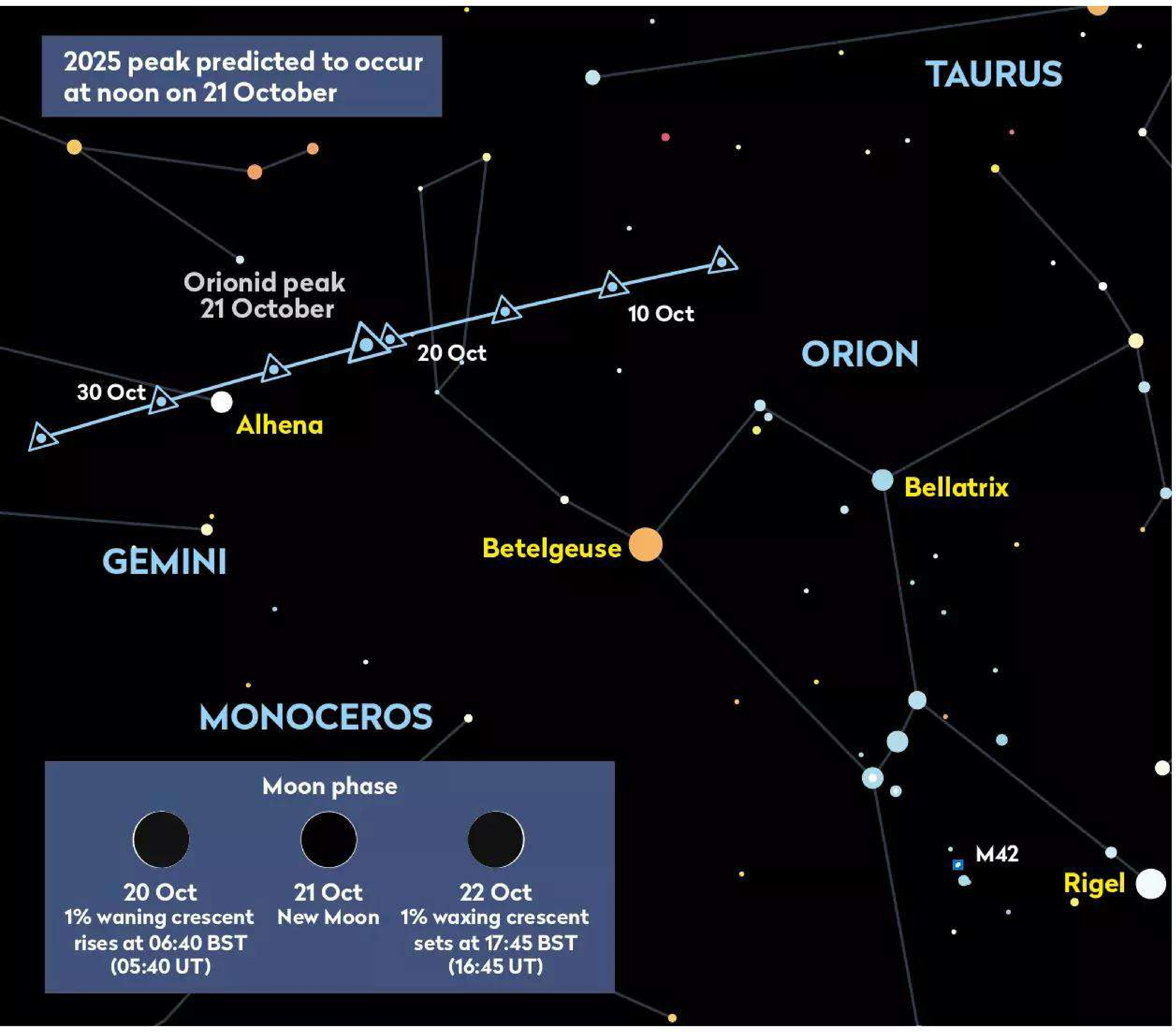
26 October End of British Summer Time, clocks go back an hour

29 October Titan occulted by Saturn (20:38 UT)

Mineral Moon ▷

Fernando Menezes, Munhoz, Minas Gerais, Brazil, 14 May 2024

October at a glance



▲ Conditions couldn't be better for the Orionid meteor shower peak

This year is the year of moon phenomena with our own Moon and the major moons of Jupiter and Saturn putting on some infrequently seen events.

The **full Moon** on 7 October is the closest to the September equinox on 22 September, making it the Harvest Moon for 2025. It's also a supermoon, or perigee full Moon (lunar perigee when the Moon is closest to Earth, occurring on 8 October).

The **Harvest Moon**'s orbital geometry relative to Earth minimises the difference between rise times for the fuller phases. Sounding more complex than it is, this is best illustrated by example. Moonrise for the 97%-lit waxing gibbous Moon on 5 October is 18:03 BST (17:03 UT). On 6 October when virtually full, it rises just 10 minutes later at 18:13 BST (17:13 UT), and then just after full Moon on the evening of 7 October rises 12 minutes later at 18:25 BST (17:25 UT). The bright Moons, which are above the horizon at roughly similar times over several evenings, are perfect for harvest collection. The average rise time difference throughout the year is 50 minutes.

Jupiter's outer Galilean moon **Callisto** transits the planet on 2 October between 07:48-11:38 BST (06:48-10:38 UT) under daylight conditions. A better-timed opportunity occurs on 19 October between 02:01-06:01 BST (01:01-05:01 UT).

Saturn's largest moon **Titan** transits Saturn on the morning of 6 October (02:25-07:44 BST (01:25-06:44 UT)) followed by its shadow (04:51-08:30 BST (03:51-07:30 UT)). On the evening of 13 October Titan is occulted by Saturn at 23:56 BST (22:56 UT). Another Titan and shadow transit occurs on the night of 21 October starting at 23:44 BST (22:44 UT), another Titan occultation starts at 20:38 UT on 29 October.

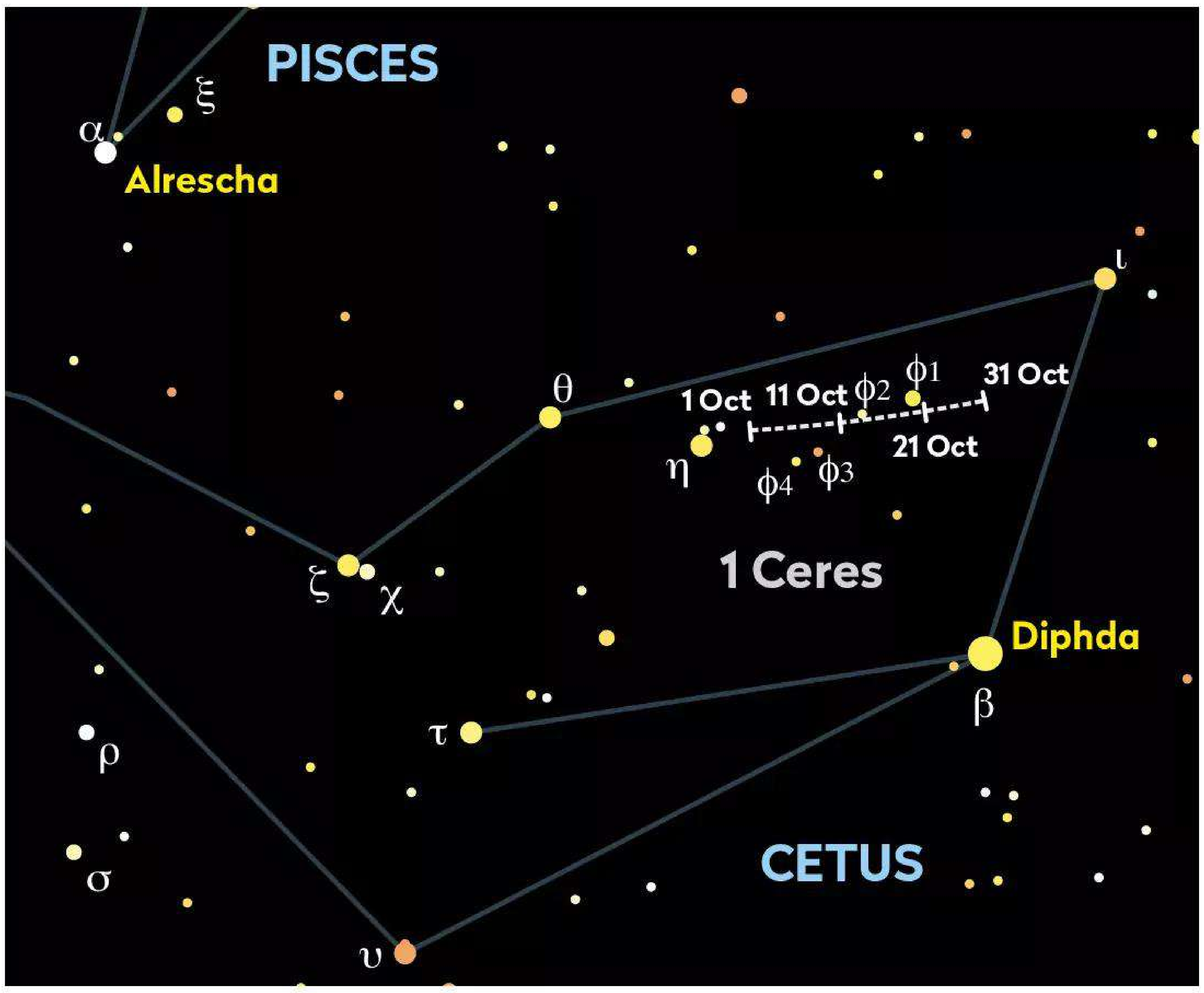
The **Orionid meteor shower** peaks at noon on 21 October, so optimal viewing nights are on 20/21 and 21/22 October. The shower produces a peak zenithal hourly rate (ZHR) of 25 meteors per hour, although what you'll actually see will be lower. Conditions are favourable this year with a new Moon on 21 October.

A new Moon is ideal for viewing stars and constellations. Early evening in the autumn, the most prominent shape is the large, but not bright, **Great Square of Pegasus**. South of the Square lies the even fainter stars of the **Circlet asterism**, representing the western fish of Pisces, the Fish. **Saturn** and **Neptune** are currently both located just southeast of the Circlet.

Southwest of the Circlet is the large sprawling constellation of **Aquarius, the Water Bearer**, its most distinguishing feature being the three-pronged Water Jar asterism, also known as the **Steering Wheel**. Follow the line of the western edge of the Great Square of Pegasus south and eventually you'll arrive at the most southerly first magnitude star visible from the UK, **Fomalhaut** (Alpha (α) Piscis Austrinus).

The northeast corner of the Great Square is marked by **Alpheratz** (Alpha (α) Andromedae) the primary star of **Andromeda, the Chained Princess**. The main form of this constellation appears like a large wedge spreading northeast from Alpheratz. Located half-way along the northern edge of the wedge is the **Andromeda Galaxy M13**, the farthest object visible with the naked eye from a typical back garden location, lying at a distance of 2.5 million lightyears.

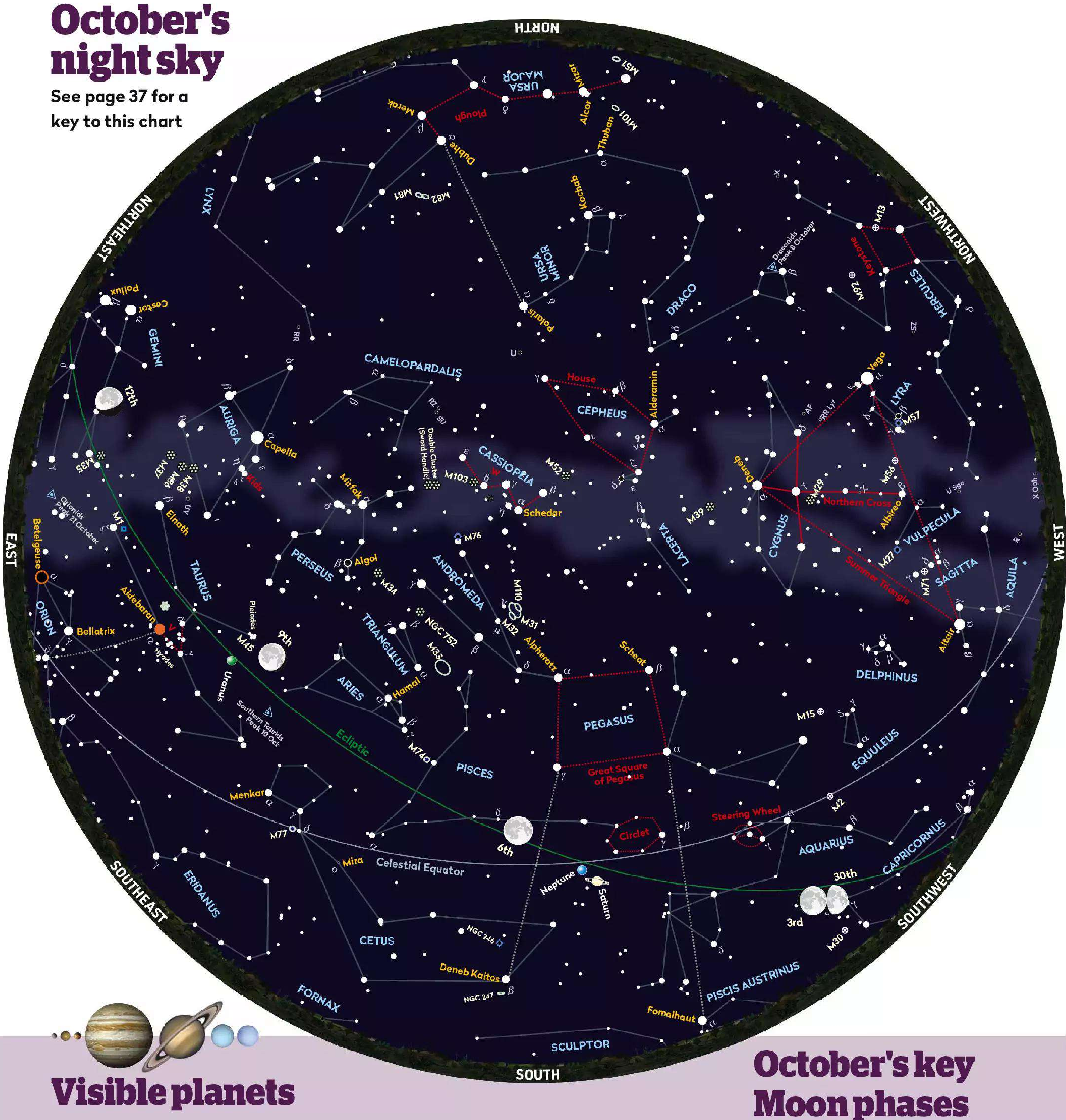
▼ Dwarf planet Ceres reaches opposition on 2 October, shining at mag. +7.5 against the stars of Cetus



PETE LAWRENCE X 3, ISTOCK X 7, NASA X 4

October's night sky

See page 37 for a key to this chart


NORTH
NORTHEAST
NORTHWEST
EAST
WEST
SOUTHEAST
SOUTHWEST
SOUTH
URSA MAJOR
Merak
Plough
Dubhe
Alcor
Mizar
M51
M101
Thuban
M81
M82
Kochab
URSA MINOR
Polaris
LYNX
DRACO
Draconids Peak 8 October
M13
Keystone
M92
HERCULES
Pollux
Castor
GEMINI
12th
CAMELOPARDALIS
House
CEPHEUS
Alderamin
Vega
LYRA
M57
AURIGA
Capella
M35
M37
M36
M38
Kids
Elnath
Orionids Peak 21 October
M1
Double Cluster (Sword Handle)
CASSIOPEIA
W
M103
M52
Schedar
Mirfak
Deneb
M29
Northern Cross
M56
Albireo
CYGNUS
M39
LACERTA
VULPECULA
M27
SAGITTA
M71
Summer Triangle
Altair
AQUILA
Betelgeuse
ORION
Bellatrix
Aldebaran
Hyades
TAURUS
PERSEUS
Algol
M34
M76
ANDROMEDA
M110
M31
M32
Pleiades
M45
9th
Uranus
TRIANGULUM
NGC 752
M33
ARIES
Hamal
Alpheratz
Scheat
DELPHINUS
PEGASUS
Southern Taurids Peak 10 Oct
Ecliptic
M74
PISCES
Great Square of Pegasus
M15
EQUULEUS
Menkar
M77
Mira
Celestial Equator
6th
Circlet
Steering Wheel
M2
AQUARIUS
CAPRICORNUS
30th
Neptune
Saturn
3rd
M30
ERIDANUS
CETUS
NGC 246
Deneb Kaitos
NGC 247
FORNAX
PISCIS AUSTRINUS
Fomalhaut
SCULPTOR

Visible planets

Where to spot the planets this month

Mercury
Greatest eastern elongation on 29 October, but too low in the evening sky to be seen.

Venus
Morning planet, rising 2 hours and 15 minutes before sunrise on 1 October. Harder to see at the end of October.

Mars
Evening planet, not visible.

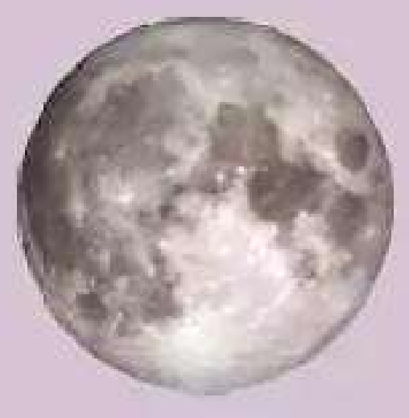
Jupiter
Bright morning planet. Reaches 58° altitude under darkness at end of month.

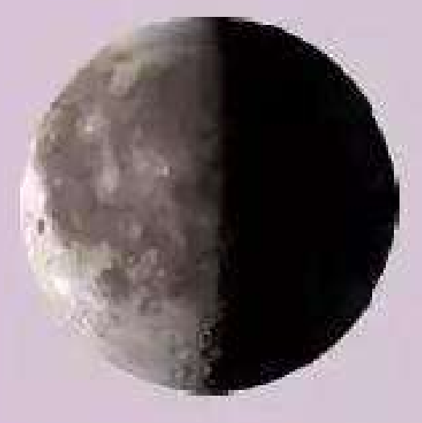
Saturn
Evening planet, in Aquarius. Reaches 34° altitude from the UK.

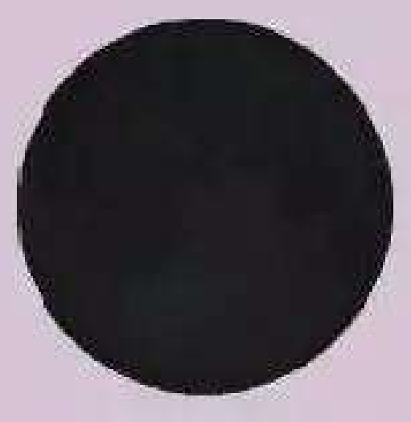
Uranus
Well-placed morning planet south of the Pleiades, reaching 57° altitude.

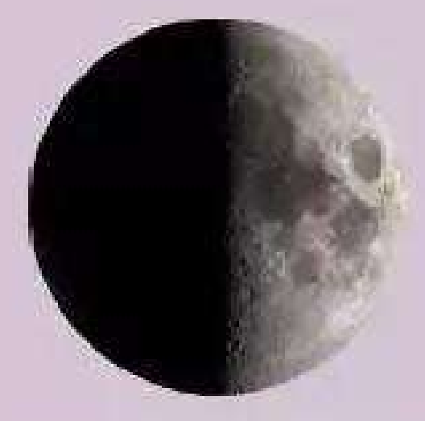
Neptune
Evening planet, in Pisces. Reaches 36° altitude when due south.

October's key Moon phases


FULL MOON
7 Oct


LAST QUARTER
13 Oct


NEW MOON
21 Oct


FIRST QUARTER
29 Oct

November

A comet buzzes the Beehive and Titan is covered first by Saturn, then its shadow

8-11 November Comet 24P/Schaumasse crosses the Beehive Cluster, M44

14 November Titan occulted and partially eclipsed by Saturn

17 November Leonid meteor shower peak

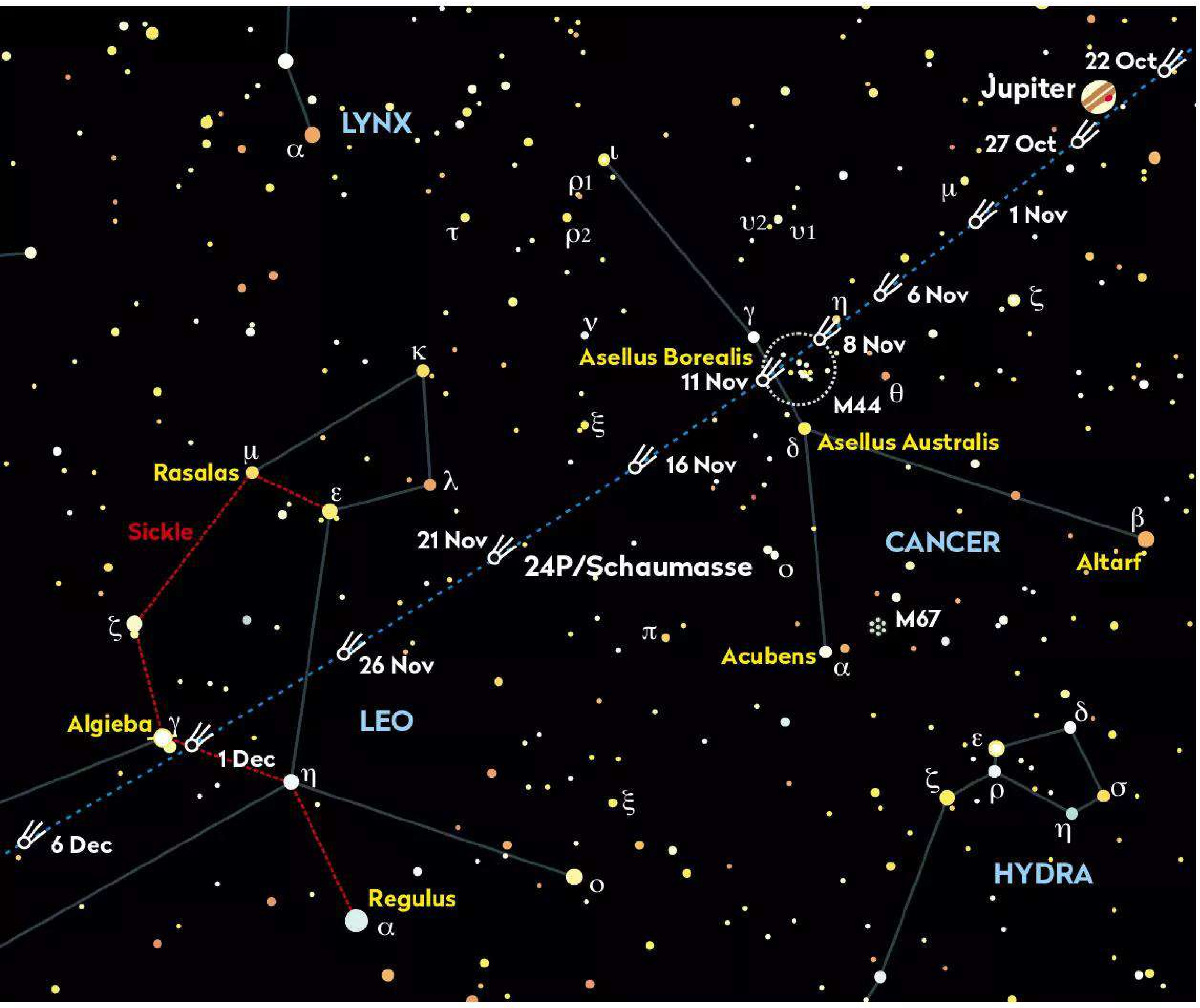
21 November Uranus at opposition (evening)

22 November Titan transits Saturn (18:52-01:10 UT)

The Pleiades ▷

Harshwardhan Pathak, captured remotely via Telescope Live, Heaven's Mirror Observatory, Australia and IC Astronomy Observatory, Spain, 10 September–18 November 2023

November at a glance


22 Oct
Jupiter
27 Oct
1 Nov
6 Nov
8 Nov
11 Nov
16 Nov
21 Nov
26 Nov
1 Dec
6 Dec
LYNX
α
ρ1
ρ2
ι
τ
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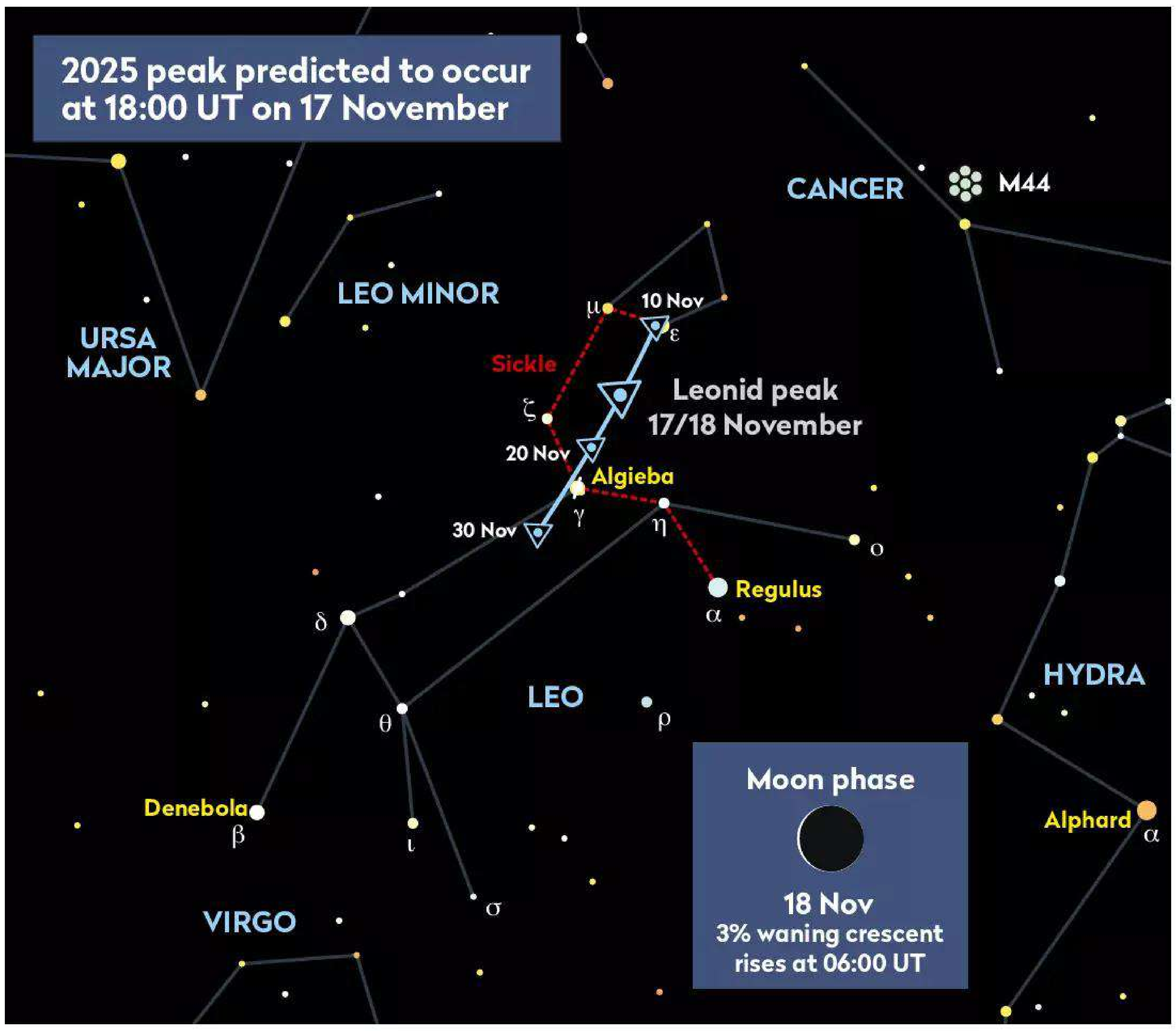
μ
η
ζ
γ
κ
Asellus Borealis
M44
θ
Asellus Australis
δ
ξ
Rasalas
μ
λ
ε
Sickle
24P/Schaumasse
ο
CANCER
β
Altarf
M67
π
Acubens
α
ζ
Algieba
γ
LEO
η
ε
δ
ζ
ρ
σ
η
HYDRA
ξ
Regulus
α
ο

▲ Comet 24P/ Schaumasse appears to cross the Beehive Cluster M44 on 8-11 November

Long, dark November nights are ideal for observing the stars and constellations. Early evening you can still view the stars of summer, including the Summer Triangle asterism. Given a clear, dark, moonless sky, you can still follow the summer Milky Way right down to the core region in **Sagittarius, the Archer**. To the west of this rich part of the sky is the triangular sandwich-shaped pattern of **Capricornus, the Sea Goat**, opening the door to the watery constellations of autumn, including **Aquarius, the Water Bearer**, **Piscis Austrinus, the Southern Fish** and **Pisces, the Fish**.

▼ Leonid meteor shower peak predicted for early evening on 17 November


2025 peak predicted to occur at 18:00 UT on 17 November
CANCER
M44
LEO MINOR
URSA MAJOR
μ
10 Nov
ε
Sickle
Leonid peak 17/18 November
ζ
20 Nov
Algieba
30 Nov
γ
η
ο
Regulus
α
δ
LEO
θ
ρ
HYDRA
Denebola
β
ι
VIRGO
σ
Alphard
α
Moon phase
18 Nov
3% waning crescent
rises at 06:00 UT

PETE LAWRENCE X 3, ISTOCK X 7, NASA X 4

Further east still, the wet theme spills into the winter sky with **Cetus, the Whale** east of Aquarius, followed by the long winding pattern of **Eridanus, the River** starting near the bright star Rigel (Beta (β) Orionis) in the southwest corner of **Orion, the Hunter**. Orion moves into a prominent position in the early morning. The impressive stars of winter around Orion include **Canis Major, the Great Dog**, **Canis Minor, the Little Dog**, **Gemini, the Twins** and **Taurus, the Bull**, the latter bridging the gap between autumn and winter.

You can find the two brightest stars in Gemini, **Castor** (Alpha (α) Geminorum) and **Pollux** (Beta (β) Geminorum) by following the line from Rigel through Betelgeuse (Alpha (α) Orionis) in Orion's northeast corner, for twice that distance again. Castor and Pollux represent the heads of the heavenly twins. Although similar, Pollux is slightly brighter and redder.

Located east of Gemini is a very early taste of spring with **Cancer, the Crab**, a faint inverted-Y pattern with the beautiful **Beehive Cluster M44**, at its core. Between 8-11 November ninth magnitude **comet 24P/Schaumasse** appears to cross this cluster. This provides an easy way to locate the comet and a wonderful photo opportunity. The only problem will be a bright Moon nearby, which will really make the diffuse comet harder to see. Don't be put off though because, as 24P continues to track east, it is predicted to brighten, reaching mag. +7.6 at the end of November, and will be located within the backward question mark asterism known as **the Sickle** in Leo, the Lion.

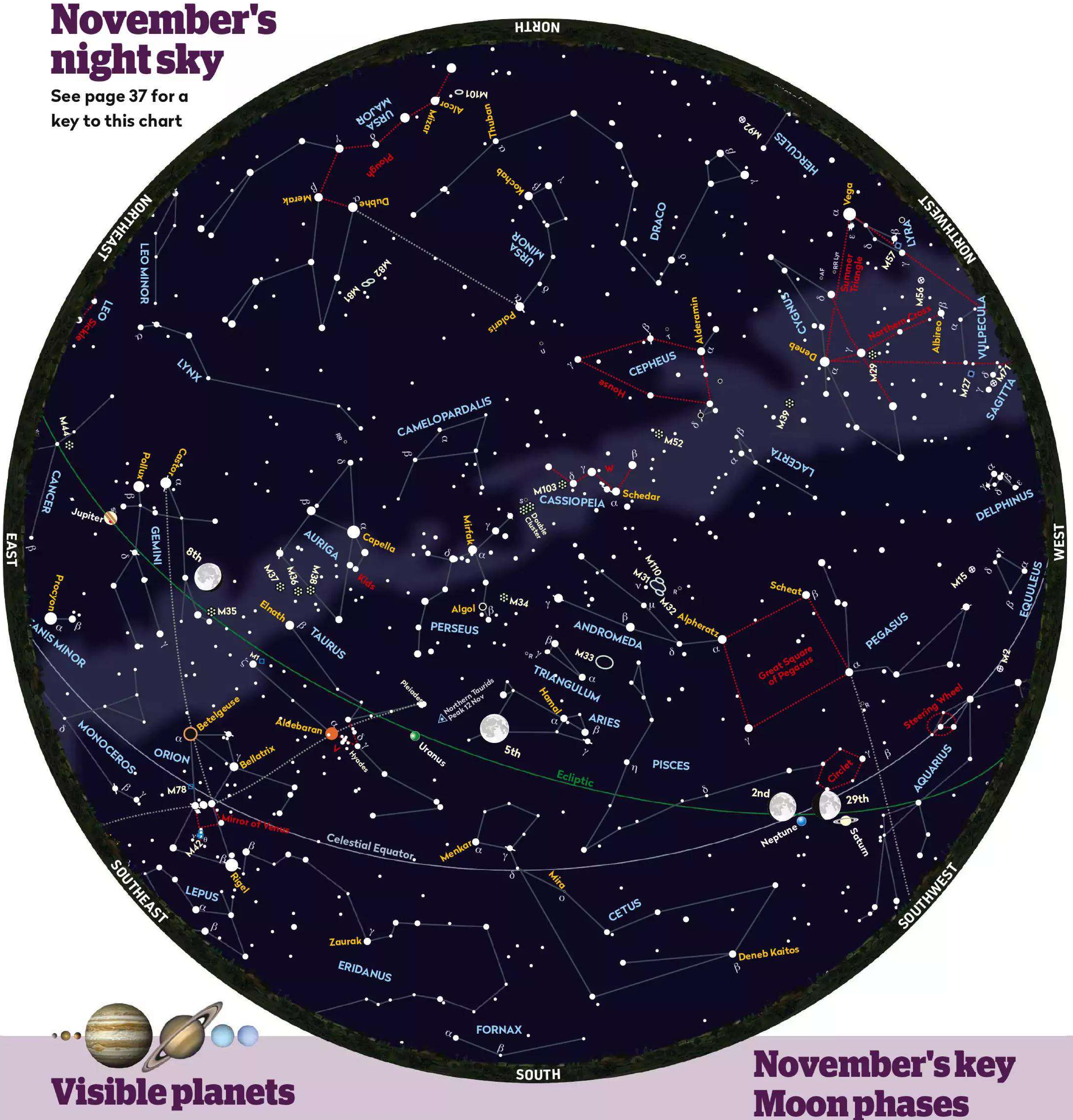
The Sickle is significant for another annually occurring event that happens in November, the **Leonid meteor shower**. This year's shower peaks on the evening of 17 November, giving the best views later that night and into the morning of 18 November. The Leonid shower is active between 6-30 November producing a ZHR of around 15 meteors per hour during a typical peak period.

A number of interesting Titan-related events occur this month. After **Titan** is occulted by Saturn between 18:48-00:35 UT on 14/15 November, the moon then goes on to be partially eclipsed by Saturn's shadow from 01:25 UT until the planet sets just after 02:00 UT. The partial eclipse starts with Saturn at a tricky 5° altitude.

Then, on 22 November, there's a well-timed transit of Titan between 18:52-01:10 UT and another occultation by Saturn can be seen on 30 November between 17:22-23:24 UT. If you're wondering why we have put a lot of emphasis on Titan-related events this year, it's because they will gradually start to peter out during the first part of 2026, and the next set won't occur for approximately 13 years.

November's night sky

See page 37 for a key to this chart


NORTH
NORTHEAST
NORTHWEST
EAST
WEST
SOUTHEAST
SOUTHWEST
SOUTH
URSA MAJOR
Alcor
Mizar
M101
Plough
Merak
Dubhe
Thuban
Kochab
URSA MINOR
Polaris
M81
M82
HERCULES
M92
DRACO
LYRA
Vega
M57
Summer Triangle
CYGNUS
Deneb
Northern Cross
M56
Albireo
VULPECULA
M27
M71
SAGITTA
M29
M39
CEPHEUS
Alderamin
House
M52
LACERTA
DELPHINUS
LEO MINOR
LEO
Sickle
LYNX
CAMELOPARDALIS
M44
CANCER
Pollux
Castor
Jupiter
GEMINI
8th
M35
Procyon
CANIS MINOR
AURIGA
Capella
Kids
M37
M36
M38
Elnath
TAURUS
M1
Mirfak
Double Cluster
M103
CASSIOPEIA
Schedar
W
PERSEUS
Algol
M34
M31
M110
M32
ANDROMEDA
Alpheratz
Scheat
Great Square of Pegasus
PEGASUS
M15
EQUULEUS
M2
Steering Wheel
AQUARIUS
M33
TRIANGULUM
Hamal
ARIES
Pleiades
Northern Taurids Peak 12 Nov
Uranus
5th
Aldebaran
Hyades
Betelgeuse
ORION
Bellatrix
MONOCEROS
M78
Mirror of Venus
M42
Rigel
LEPUS
Celestial Equator
Ecliptic
PISCES
Circlet
2nd
29th
Neptune
Saturn
Menkar
Mira
CETUS
Deneb Kaitos
Zaurak
ERIDANUS
FORNAX

Visible planets

Where to spot the planets this month

Mercury
After inferior conjunction on 20 November, visible in the morning sky at the end of the month.

Venus
Morning planet rising 1 hour 40 minutes before sunrise on 1 November, lost by the end of the month.

Mars
Not visible this month.

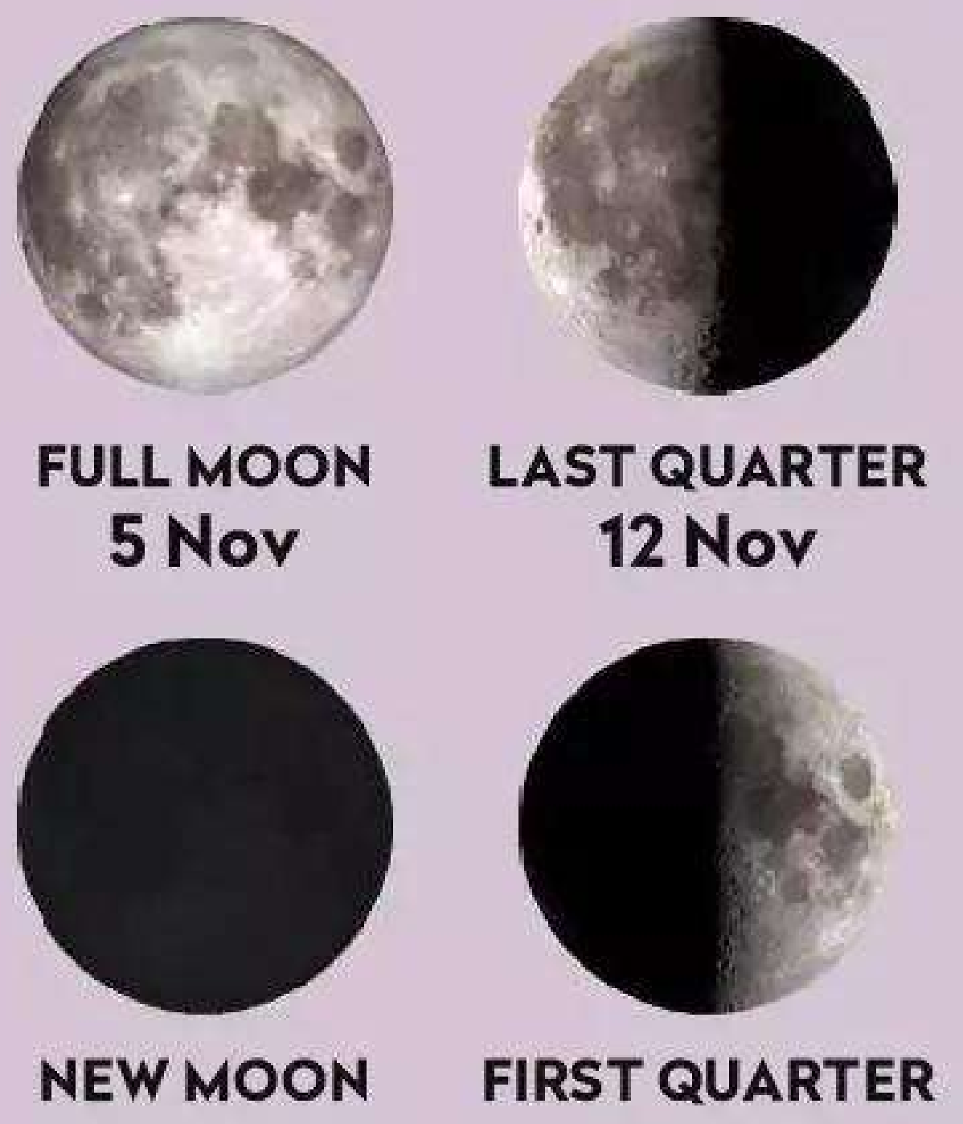
Jupiter
Superb morning planet in Gemini reaching just shy of 60° altitude when due south.

Saturn
Well-positioned evening planet, reaching 33° altitude under dark sky conditions all month.

Uranus
Well-positioned evening planet, reaching 57° altitude when due south. Opposition on 21 November.

Neptune
Evening planet near Saturn.

November's key Moon phases


FULL MOON
5 Nov
LAST QUARTER
12 Nov
NEW MOON
20 Nov
FIRST QUARTER
28 Nov

CAMELOPARDALIS
Pherkad
γ
ζ
URSA
MINOR
η
α
Polaris
δ
ε
5°
E
N
S
W
NGC 188
DRACO
χ
ϕ
ρ
κ
τ
υ
Errai
γ
Collinder 463
CEPHEUS
π
δ
ε
Altais
NGC 40
16
24
π
Alfirk
11
ρ
β
NGC 7023
House
4
ο
7
θ
κ
King 14
6
ι
η
26
ξ
Kurhah
α
NGC 6939
W
Alderamin
NGC 129
NGC 7790
18
9
o
NGC 6946
30
25
20
NGC 7160
M52
19
β
ν
Caph
NGC 7510
12
Markarian 50
ρ
τ
λ
μ
IC 1396
NGC 7789
δ
ζ
14
NGC 7380
NGC 7261
NGC 7235
ε
13
CASSIOPEIA
Berkeley 94
CYGNUS
LACERTA
NGC 7086
π1
AND
β
NGC 7243
π2
IC 1369
NGC 7686
M39
α
NGC 7000

Constellation of the season

WINTER: Cepheus

Cepheus represents a king of Ethiopia, husband of Queen Cassiopeia and father of Andromeda. Boasting that their daughter was the most beautiful creature on Earth, Cassiopeia angered the sea god Poseidon, who sent the sea monster Cetus to ravage the kingdom in revenge. Cepheus was advised to take Andromeda to the shore and chain her to a rock as sacrifice to Cetus. But the sacrifice was thwarted by the Greek hero Perseus, who rescued Andromeda and turned Cetus to stone by showing it the head of the Gorgon Medusa. Victorious, Perseus claimed Andromeda for his bride. But Andromeda had been promised to Cepheus's brother Phineus who, with some support, gate-crashed the wedding feast. A bloody battle ensued. Cepheus eventually left the fight, and Perseus made good use of the Gorgon's head again to turn the remainder of Phineus's attackers to stone.

Upside down king

As a constellation, Cepheus is described as resembling a child's drawing of a house; a classic square base with a triangular roof. But viewing the tip of the roof as the top of the house gives the wrong impression of Cepheus's orientation, the king's head supposedly marked by the star grouping in the bottom-left (southeast) corner of the house. His feet lie north of the roof near the North Celestial Pole approximately marked by Polaris.

Imagining the house pattern the correct way up, the star in the lower-right (southwest) corner is Alderamin (Alpha (α) Cephei), a name meaning 'the right arm'. There are three stars in the lower-left (southeast) corner, the one slightly further east is Delta (δ) Cephei, the important prototype for the Cepheid class of variable star. Its importance comes about because its period of variation is directly proportional to its luminosity. If you can identify similar variable types in say a distant galaxy, knowing their period tells you how luminous they are. Therefore, from their apparent luminosity you can determine how far away a Cepheid must be in order to appear as bright as it does.

The Milky Way clips into the southern part of the house, covering about half of the bottom square. This region is rich in deep-sky objects, such as the expansive IC 1396 region, a large, low surface brightness area of emission nebulosity hanging south off the house's base. This region contains the popular Elephant's Trunk Nebula IC 1396A, a dark patch with a bright edge which vaguely resembles the profile of an elephant's head, a wispy tendril of nebulosity representing a trunk.

Located against the northern edge of IC 1396 is Erakis (Mu (μ) Cephei) a red variable star. Known as Herschel's Garnet Star, Mu's deep orange appearance hides the fact that it's a monstrous supergiant star, possibly a hypergiant, estimated to be about 1,000 times larger and 200,000 times more luminous than our Sun.

The Wizard Nebula is an emission nebula Sh2-142, surrounding a young cluster of stars NGC 7380. It's located 2.4° east of Delta Cephei. Visually, the nebula is very hard to see, a 250mm scope revealing about 40 stars in the associated cluster.

West of the lower section of the House asterism is NGC 7023 the Iris Nebula. This bright reflection nebula surrounds the mag. +7.4 star, HD 200775. Visible through binoculars, in order to see it, centre on HD 200775, and use averted vision, looking slightly to the side of the star, then try to spot the faint glow of the nebula around it.

▼ Left: The Iris Nebula, NGC 7023, is a beautiful reflection nebula surrounding mag. +7.4 star HD 200775

Right: Sharpless Sh2-142 refers to the Wizard Nebula, its embedded cluster is catalogued as NGC 7380

ALL PICTURES: PETE LAWRENCE

December

Transits of Titan and peaks of two meteor showers round off the year

4 December Moon occults the Pleiades (early morning)

8 December Titan transits Saturn (17:38-23:52 UT)

13/14 December Geminid meteor shower peak

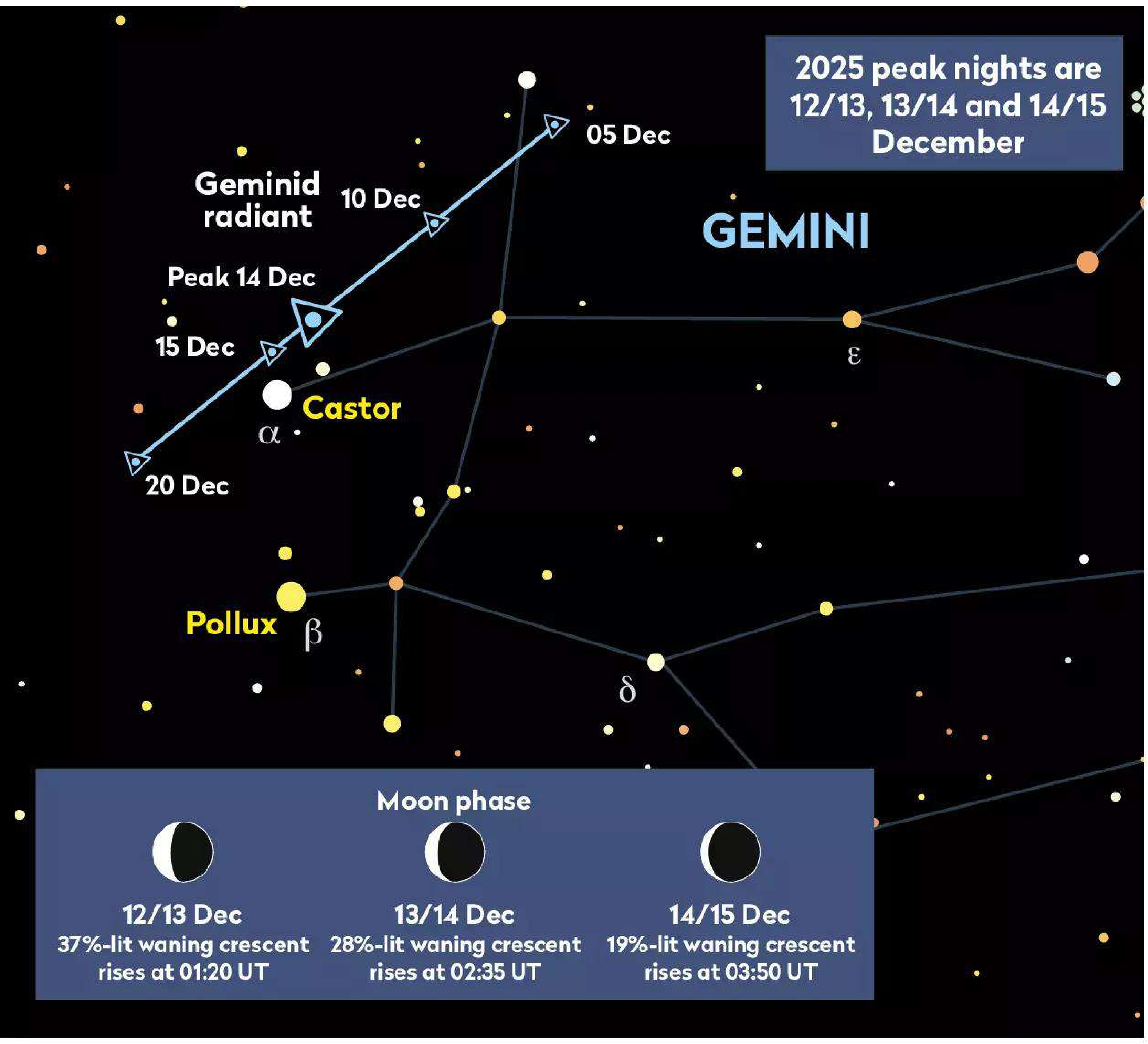
22 December Ursid meteor shower peak

24 December Titan transits Saturn (16:58-22:59 UT)

The Running Chicken Nebula, IC 2944 ▷

Gerardo N Rigiroli, Mar Del Plata, Argentina, 4–7 April 2024

December at a glance


2025 peak nights are 12/13, 13/14 and 14/15 December
GEMINI
Geminid radiant
05 Dec
10 Dec
Peak 14 Dec
15 Dec
20 Dec
Castor
α
Pollux
β
δ
ε
Moon phase
12/13 Dec
37%-lit waning crescent rises at 01:20 UT
13/14 Dec
28%-lit waning crescent rises at 02:35 UT
14/15 Dec
19%-lit waning crescent rises at 03:50 UT

▲ A waning Moon shouldn't interfere too much with this year's Geminid meteor shower peak

The Northern Hemisphere's winter solstice occurs on 21 December, resulting in the longest and darkest skies of the year. As 2026 approaches, gas giants **Jupiter** and **Saturn** are well-placed, although evening twilight knocks on Saturn's door at the end of December. We've had some great Titan events this year thanks to Saturn's recent equinox, but these end next February. This month, there are two really well-timed transits on 8 and 24 December.

Jupiter's 3.1° axial tilt is significantly less than Saturn's 26.7°, but enough that its outer moon Callisto typically fails to interact with Jupiter's globe. However, Jupiter's next equinox at the end of 2026 is now close enough for some Callisto interactions.

On 7 December **Callisto**'s shadow transits Jupiter between 18:58-22:47 UT, a precursor to the moon itself transiting Jupiter's globe from 02:10-06:20 UT on 8 December. On 16 December Callisto is occulted by Jupiter's disc at 07:45 UT. Then on 24 December a busy night has **Io**, Callisto and Io's shadow in transit as Jupiter rises around 17:20 UT. Io's shadow leaves the disc at 18:49, Io following suit at 19:14 UT, then Callisto at 20:57 UT. At 23:22 UT **Europa**'s shadow makes an appearance followed by Europa at 00:12 UT. Europa's shadow leaves transit at 02:18 UT, Europa at 03:08 UT.

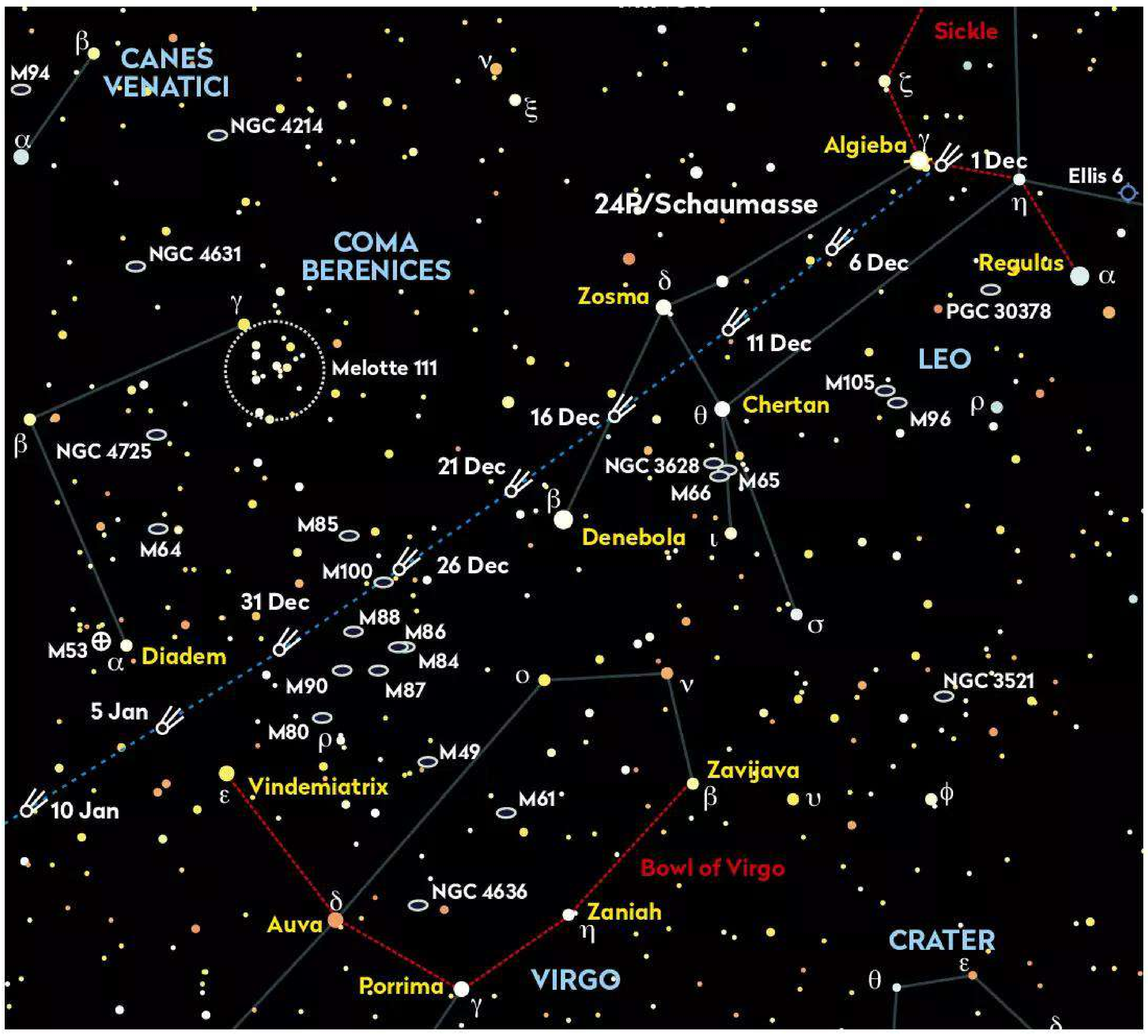
You'll need a telescope to see these events but no equipment is needed to enjoy December's two main meteor showers. The annual **Geminid meteor shower** is active between 4-17 December, the peak predicted for 08:00 UT on 14 December. A rich shower with a relatively broad peak, the best views will be on 12/13, 13/14 and 14/15 December. The Moon will a waning crescent and won't interfere much. The shower's peak ZHR is around 120 meteors per hour.

The **Ursid meteor shower** is active between 17-25 December, the peak predicted for 16:00 UT on 22 December, with the best rates expected after dusk that day. The Ursid shower has a much lower ZHR of 10 meteors per hour. New Moon on 20 December means it will be unaffected by moonlight, as well.

The stars and constellations have now turned full circle and **Orion, the Hunter** dominates the view. There are lots of deep-sky objects to look out for in and around Orion, due to the presence of the **winter Milky Way** flowing up to the left of Orion, through the feet of **Gemini, the Twins**, past the horn tips of **Taurus, the Bull** and through **Auriga, the Charioteer**. After this it passes through **Perseus, the Greek Hero**, before meandering into **Cassiopeia, the Seated Queen**.

Cassiopeia's 'W' shape is quite distinctive, and a binocular sweep of the pattern reveals many open clusters. Perhaps the best known is the pair that lie between Cassiopeia and Perseus, the Double Cluster formed from **h and Chi (χ) Persei**.

As we say goodbye to 2025, don't forget to look out for **comet 24P/Schaumasse**, which is visible in the early morning, passing from Leo, the Lion north of the Bowl of Virgo. It's a fraction brighter than sixth magnitude at the end of the month.

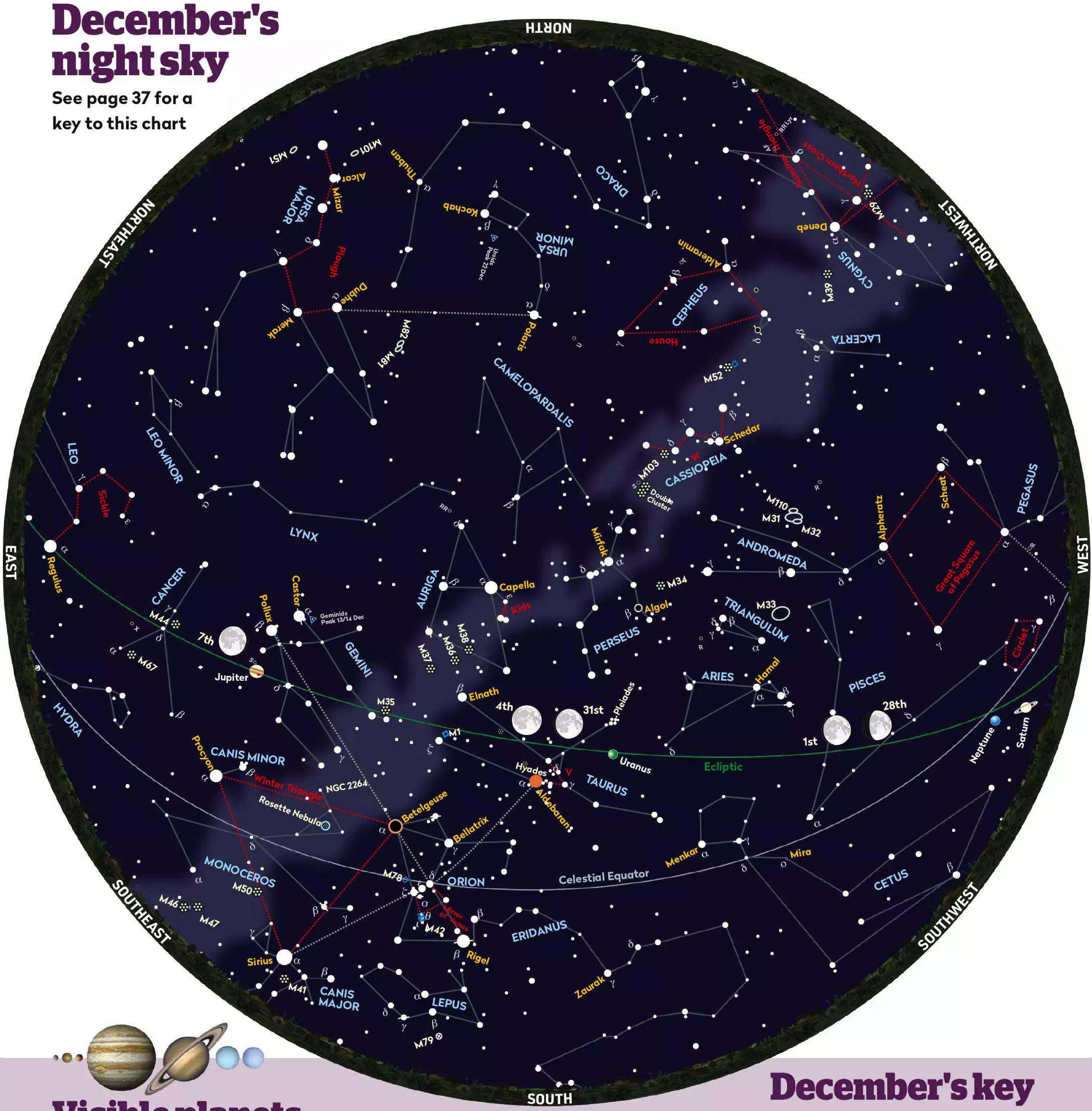

CANES VENATICI
M94
β
α
NGC 4214
ν
ξ
COMA BERENICES
NGC 4631
γ
Melotte 111
β
NGC 4725
M64
M85
M100
M53
α
Diadem
31 Dec
M88
M86
M84
M90
M87
5 Jan
M80
ρ
M49
10 Jan
ε
Vindemiatrix
M61
NGC 4636
δ
Auva
Porrima
γ
VIRGO
Sickle
ζ
Algieba
γ
1 Dec
Ellis 6
η
24P/Schaumasse
6 Dec
Regulus
α
Zosma
δ
PGC 30378
11 Dec
LEO
M105
M96
ρ
16 Dec
θ
Chertan
21 Dec
NGC 3628
M66
M65
β
Denebola
ι
26 Dec
σ
ο
ν
NGC 3521
Zavijava
β
υ
φ
Bowl of Virgo
Zaniah
η
CRATER
θ
ε
δ

▲ Comet 24P/Schaumasse brightens from mag. +7.4 to +5.9 by the end of December, peaking at +5.8 in early January 2026

PETE LAWRENCE X 3, ISTOCK X 7, NASA X 4

December's night sky

See page 37 for a key to this chart


NORTH
NORTHEAST
NORTHWEST
EAST
WEST
SOUTHEAST
SOUTHWEST
SOUTH
M51
M101
Alcor
Mizar
URSA MAJOR
Plough
Dubhe
Merak
Thuban
Kochab
Ursids Peak 22 Dec
URSA MINOR
DRACO
Polaris
M82
M81
CAMELOPARDALIS
Alderamin
CEPHEUS
House
Summer Triangle
Northern Cross
Deneb
M29
M39
CYGNUS
LACERTA
M52
Schedar
W
CASSIOPEIA
M103
Double Cluster
M110
M31
M32
ANDROMEDA
Alpheratz
Scheat
PEGASUS
Great Square of Pegasus
Circlet
LEO MINOR
LEO
Sickle
Regulus
LYNX
Mirfak
Capella
Kids
AURIGA
M34
Algol
PERSEUS
M33
TRIANGULUM
CANCER
M44
M67
Castor
Pollux
Geminids Peak 13/14 Dec
7th
Jupiter
GEMINI
M38
M36
M37
Elnath
4th
31st
Pleiades
ARIES
Hamal
PISCES
28th
1st
Neptune
Saturn
HYDRA
M35
M1
Uranus
Ecliptic
Hyades
V
TAURUS
Aldebaran
Procyon
CANIS MINOR
Winter Triangle
NGC 2264
Rosette Nebula
Betelgeuse
Bellatrix
Menkar
Mira
CETUS
MONOCEROS
M50
M46
M47
M78
ORION
Celestial Equator
Sword of Orion
M42
Rigel
ERIDANUS
Sirius
M41
CANIS MAJOR
LEPUS
M79
Zaurak

Visible planets

Where to spot the planets this month

Mercury
Morning planet visible until around 23 Dec, greatest western elongation on 7 Dec.

Venus
Morning planet but not visible this month.

Mars
Evening planet too close to the Sun to be visible.

Jupiter
Superbly positioned morning planet reaching just shy of 60° altitude when due south.

Saturn
Evening planet just able to reach peak altitude of 33° under darkness all month.

Uranus
Nicely placed evening planet, mag. +5.6 in Taurus south of the Pleiades.

Neptune
Evening binocular planet located close to Saturn. Peak altitude of 36° when due south.

December's key Moon phases

FULL MOON
4 Dec

LAST QUARTER
11 Dec

NEW MOON
20 Dec

FIRST QUARTER
27 Dec

Annular solar eclipse

Greg Meyer, Capitol Reef National Park, Utah, USA, 14 October 2023

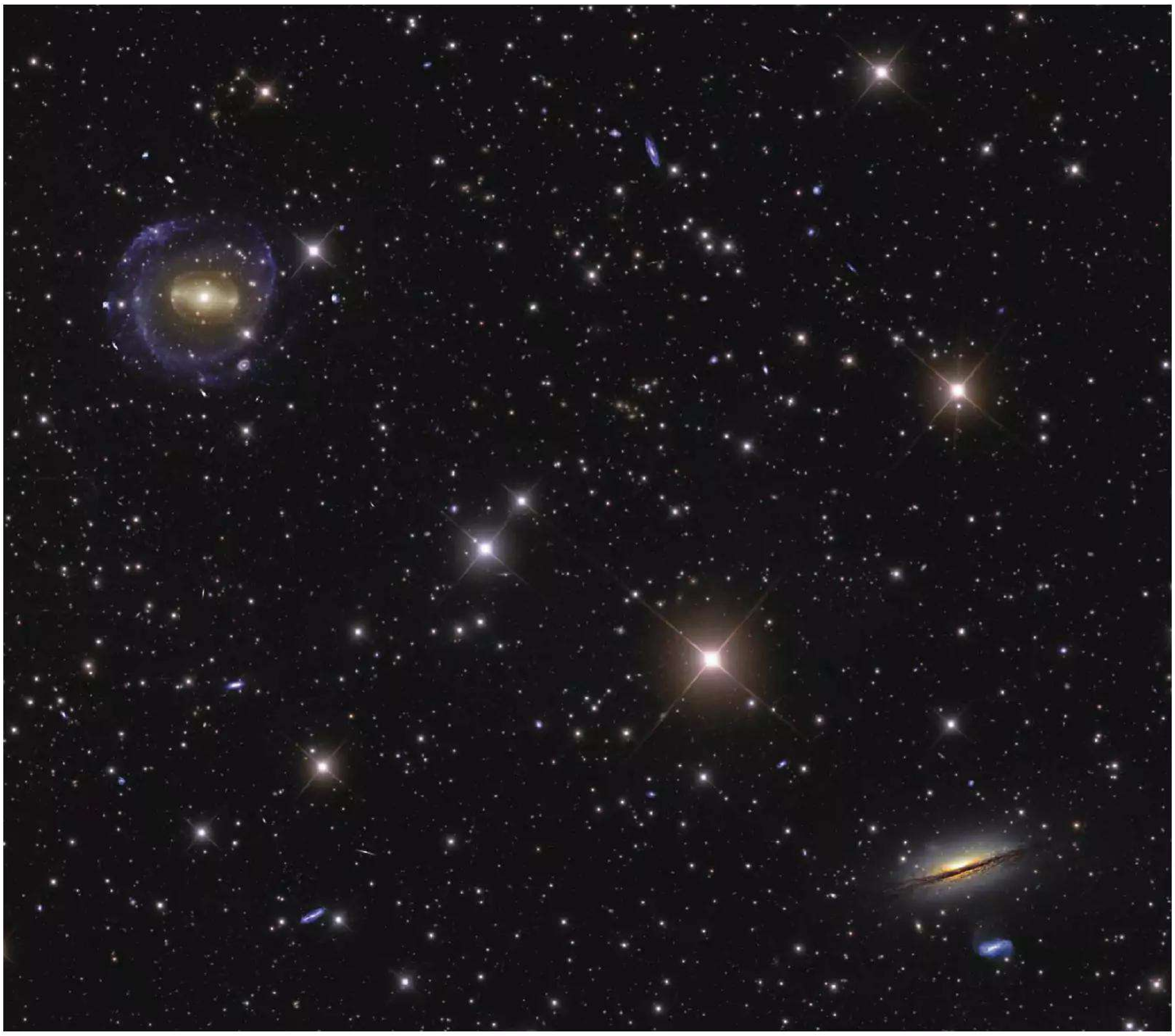
BBC Sky at Night MAGAZINE

Gallery WINNERS

Winning images from *BBC Sky at Night Magazine*'s monthly astrophotography competition in 2024

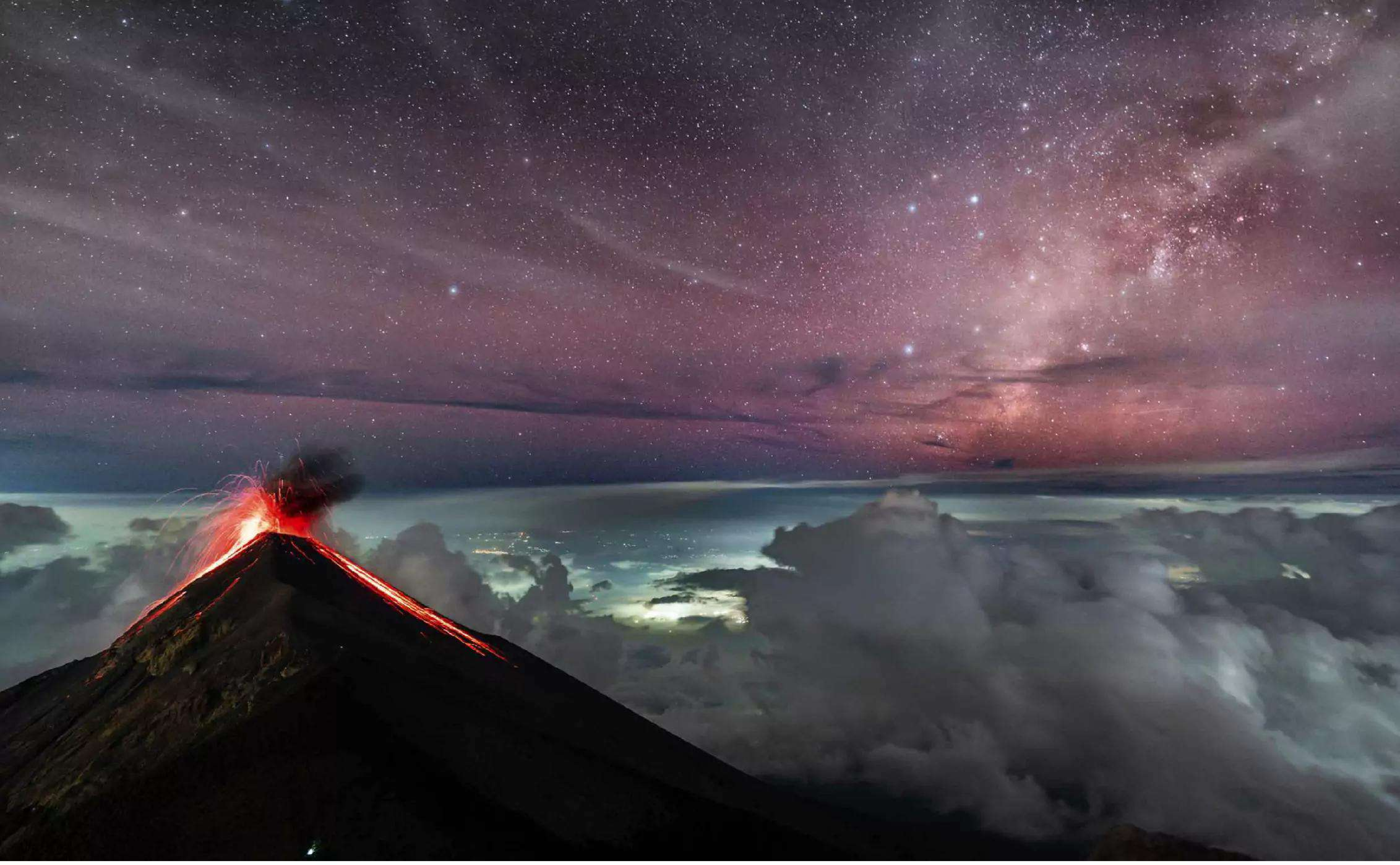
△ The Soul Nebula

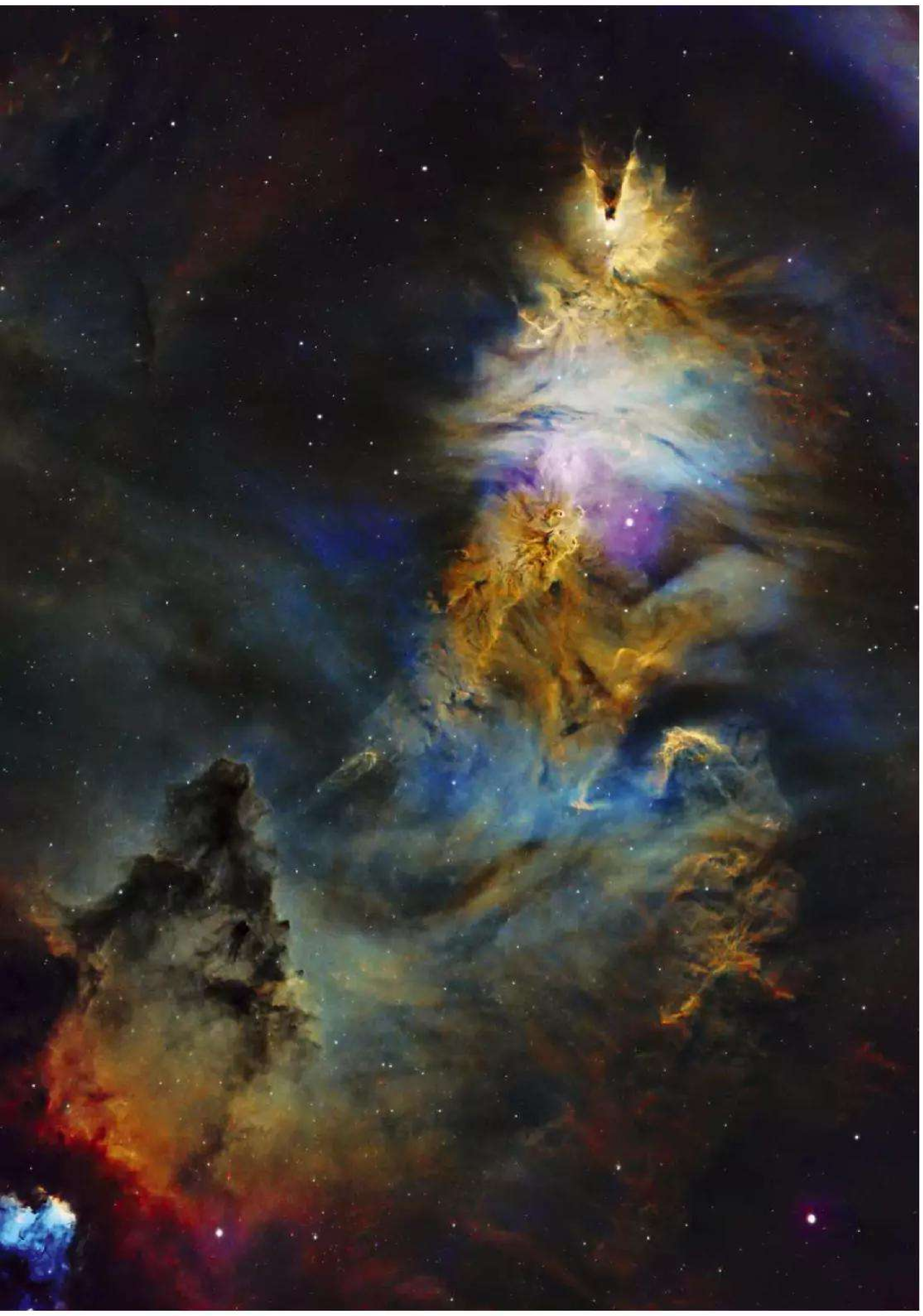
Jon Kelly, Tockwith, North Yorkshire, 10 December 2021, 19, 21 and 27 January 2022, 16–17 January 2023



NGC 5078 and NGC 5101 ▷

Daniel Stern, Rio Hurtado, Chile, March-July 2024



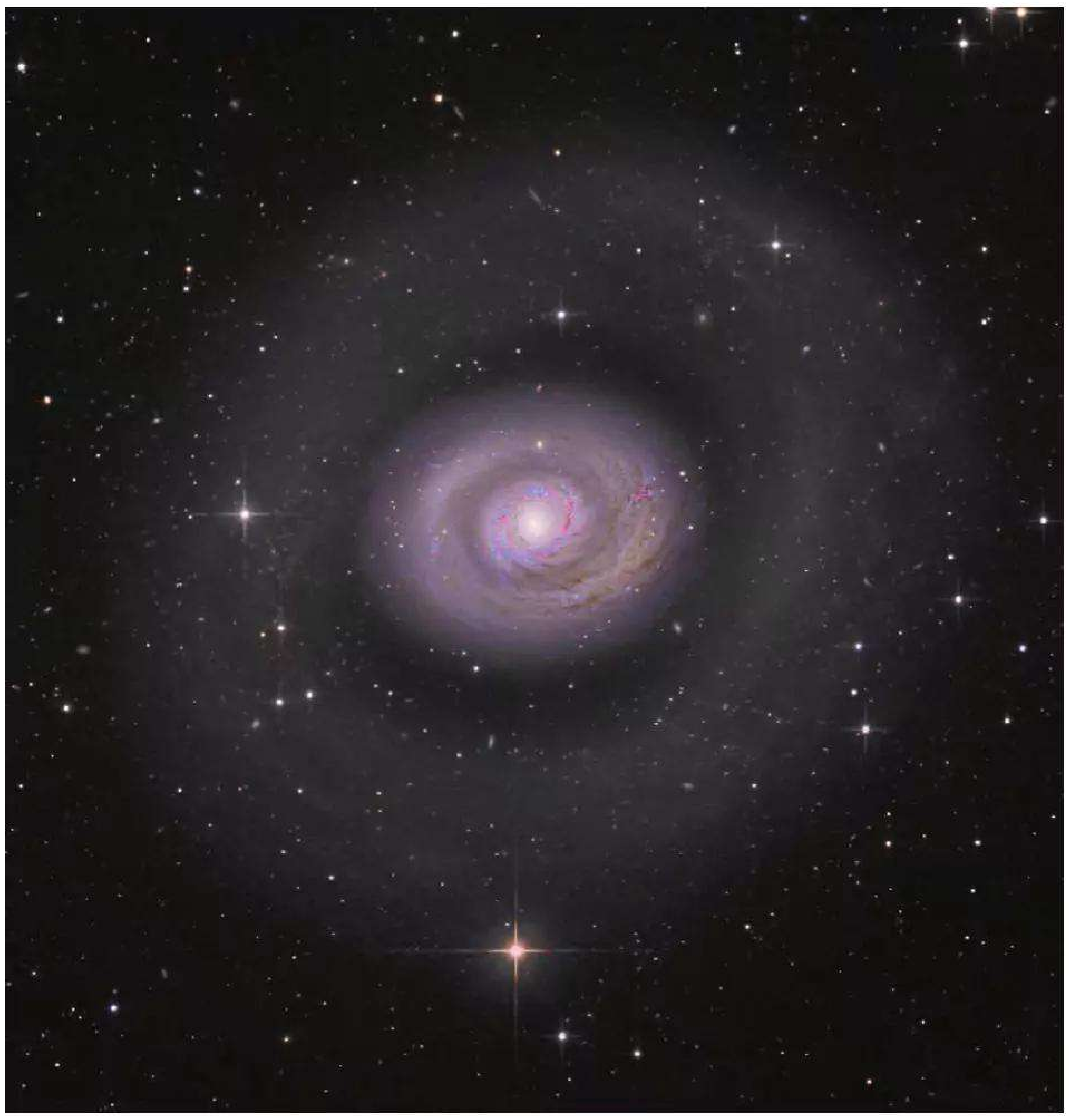


△ Milky Way over Volcán de Fuego

Chirag Upreti, Acatenango summit, Guatemala, 9 November 2023

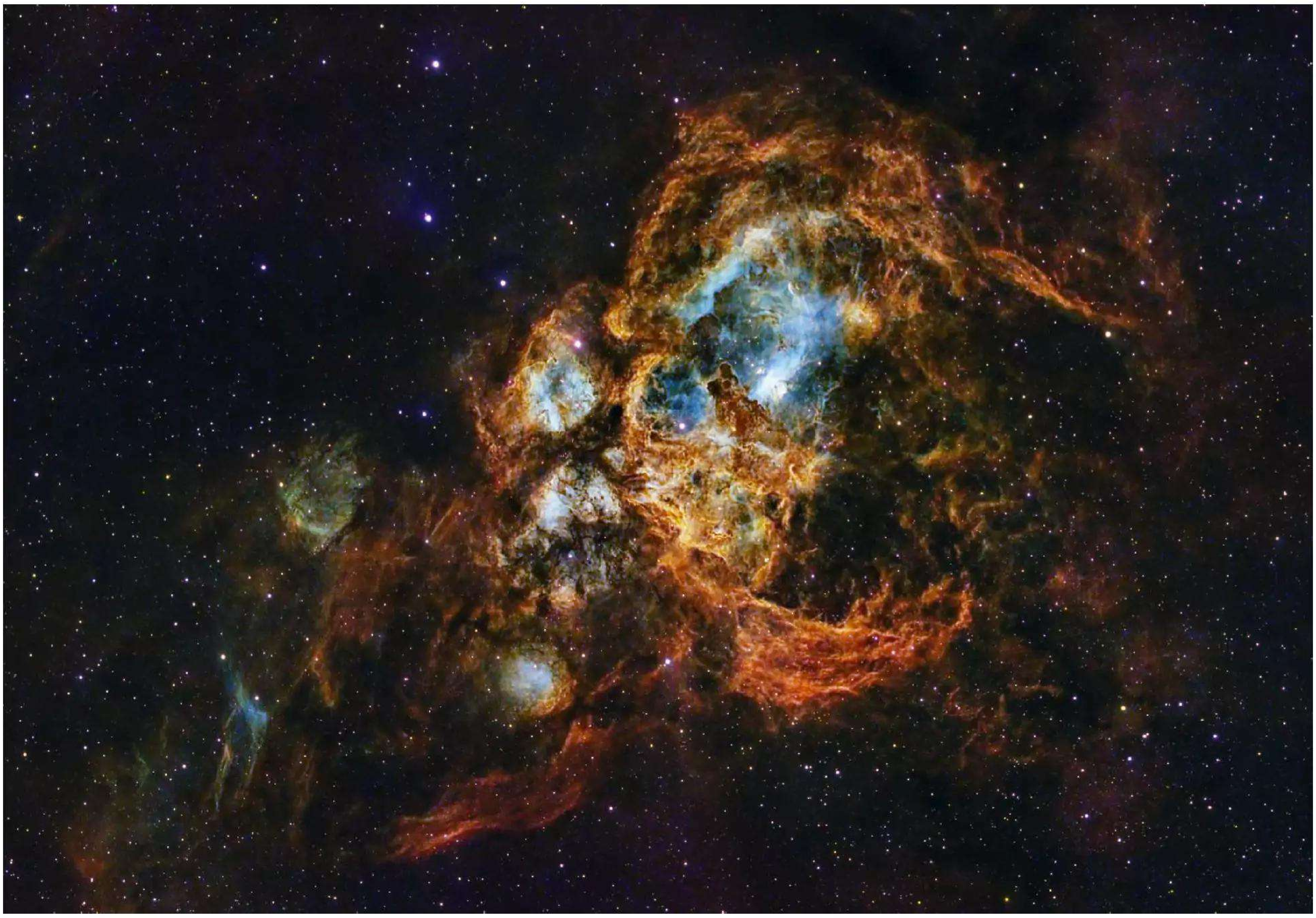
◁ The Christmas Tree Cluster

Nicole Poersch, Prestwick, South Ayrshire,
November 2023–April 2024



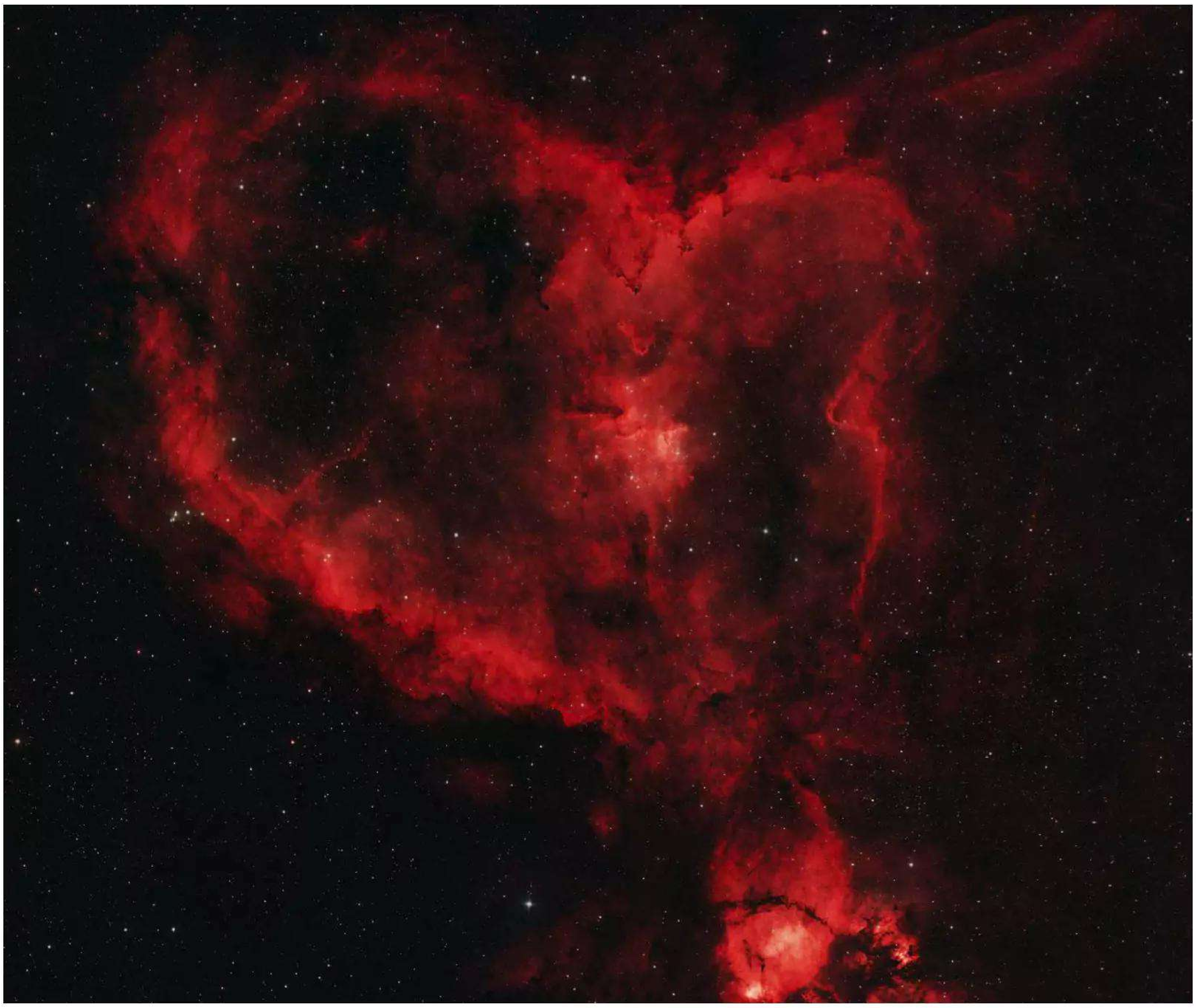
△ The Cat's Eye Galaxy, M94

Alex Battu and Luca Barcaro, Castilléjar, Andalusia, Spain, 10–14 April 2024



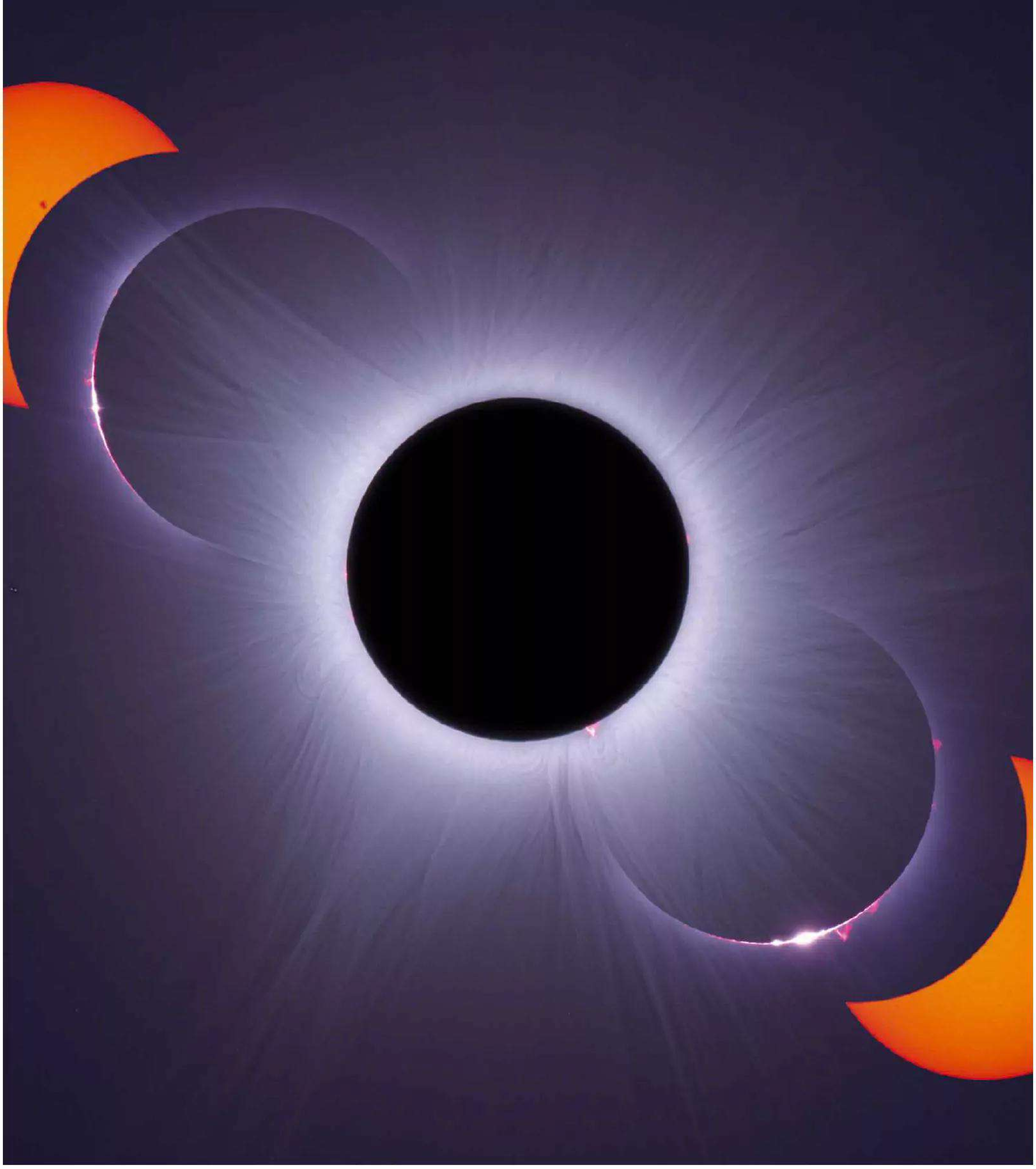
△ The Lobster Nebula

Mohammed Dawoud, Al Kharrara, Qatar, 21 June 2024



The Heart Nebula ▷

Graham Prescott, St Albans, Hertfordshire, December 2023–January 2024

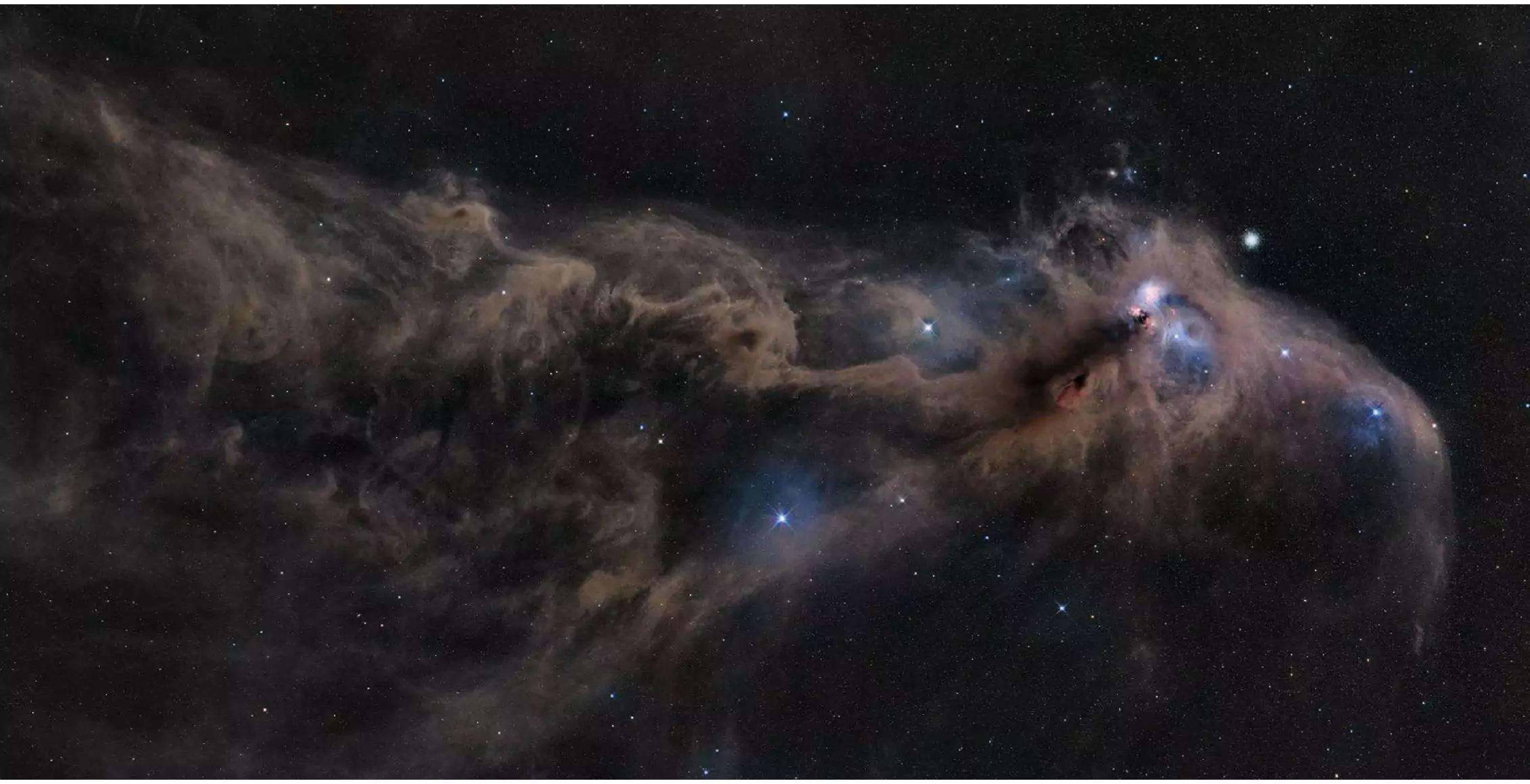


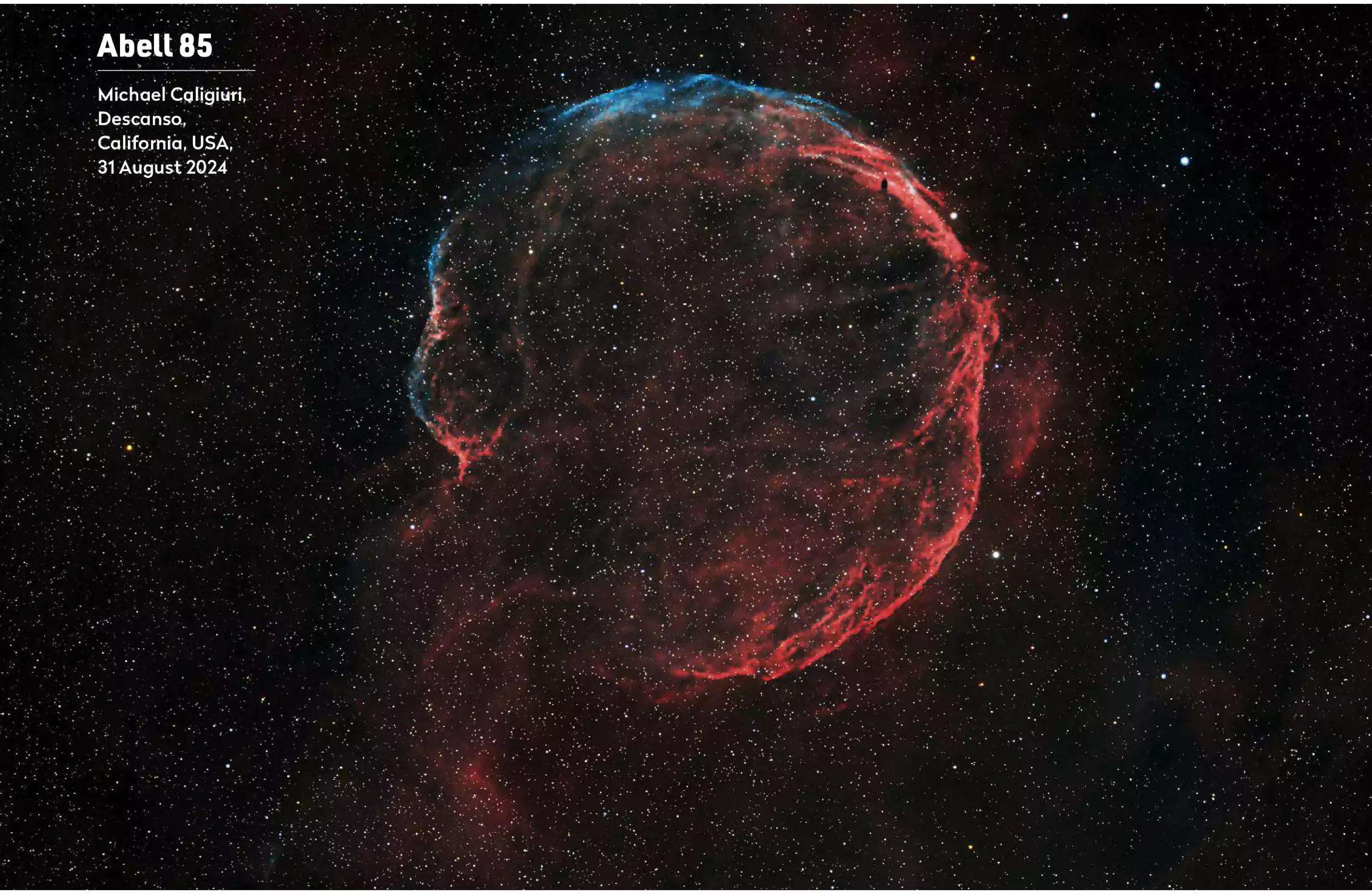
◁ Solar eclipse

Ethan Dugar,
Newport, Arizona,
USA, 8 April 2024

▽ Corona Australis molecular complex

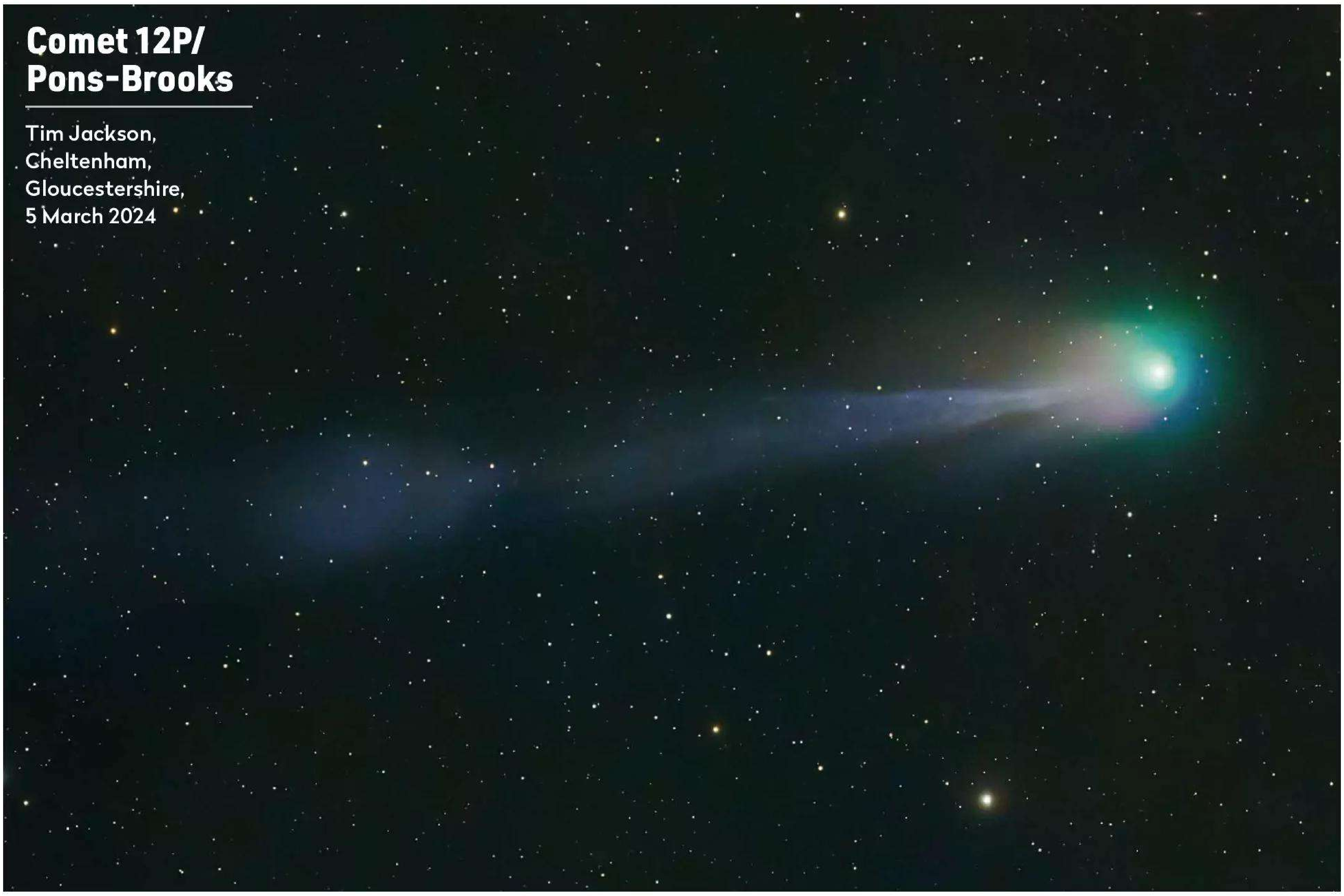
Vikas Chander,
captured remotely
via Deep Sky Chile,
7–11 July 2024





Abell 85

Michael Caligiuri,
Descanso,
California, USA,
31 August 2024



Comet 12P/Pons-Brooks

Tim Jackson,
Cheltenham,
Gloucestershire,
5 March 2024

Project 1: Observe gas giant Jupiter

Keep a watch of the Solar System's largest planet and its many moons

Jupiter near the Moon is an amazing sight when visible in a dark sky, and there are plenty of opportunities to see this in 2025

Jupiter is well presented at the start of 2025, succumbing to the rapid expansion of evening twilight throughout March and April, not recovering position again until August. Thereafter it's superbly placed for UK observing, reaching a peak altitude of around 60° when due south under dark skies. In this article, we're looking at a range of things that can be seen on and around the planet.

Conjunctions between Jupiter and the Moon

The Moon encounters Jupiter once a month. Despite lacking any scientific interest, visually the sight of bright Jupiter near the Moon is something that can stir the imagination. During 2025, some especially good encounters occur on 10 Jan, 6 Feb, 5 Mar, 2 Apr and 30 Apr in the evening sky. For morning encounters the dates are 20 Aug, 16 Sep, 14 Oct, 10 Nov and 7 Dec.

Conjunction between Jupiter and other planets

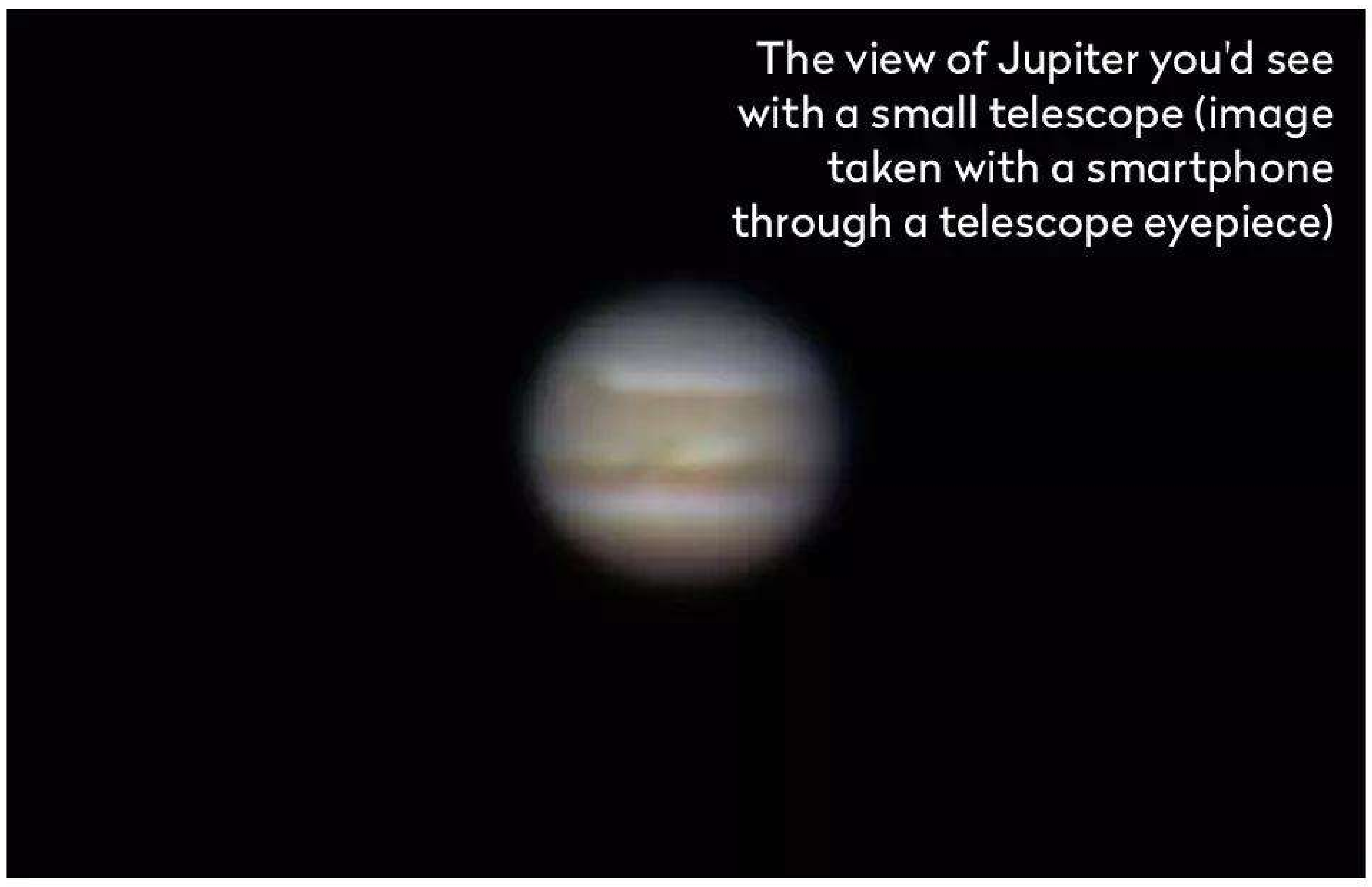
The frequency of planet-planet conjunctions is far slower than lunar meet ups. The best facilitators are the fast movers such as Mercury, Venus and Mars. Again, although there's no real scientific interest, visually such pairings can be striking. During 2025, the meet up of mag. -1.7 Jupiter with mag. -1.1 Mercury on 8 Jun is tricky to see, Jupiter is 2° south of Mercury in a bright evening twilight sky. A more striking morning conjunction with mag. -3.9 Venus occurs on 12 August, mag. -1.8 Jupiter just 53-arcminutes north of Venus on this date.

The telescope view

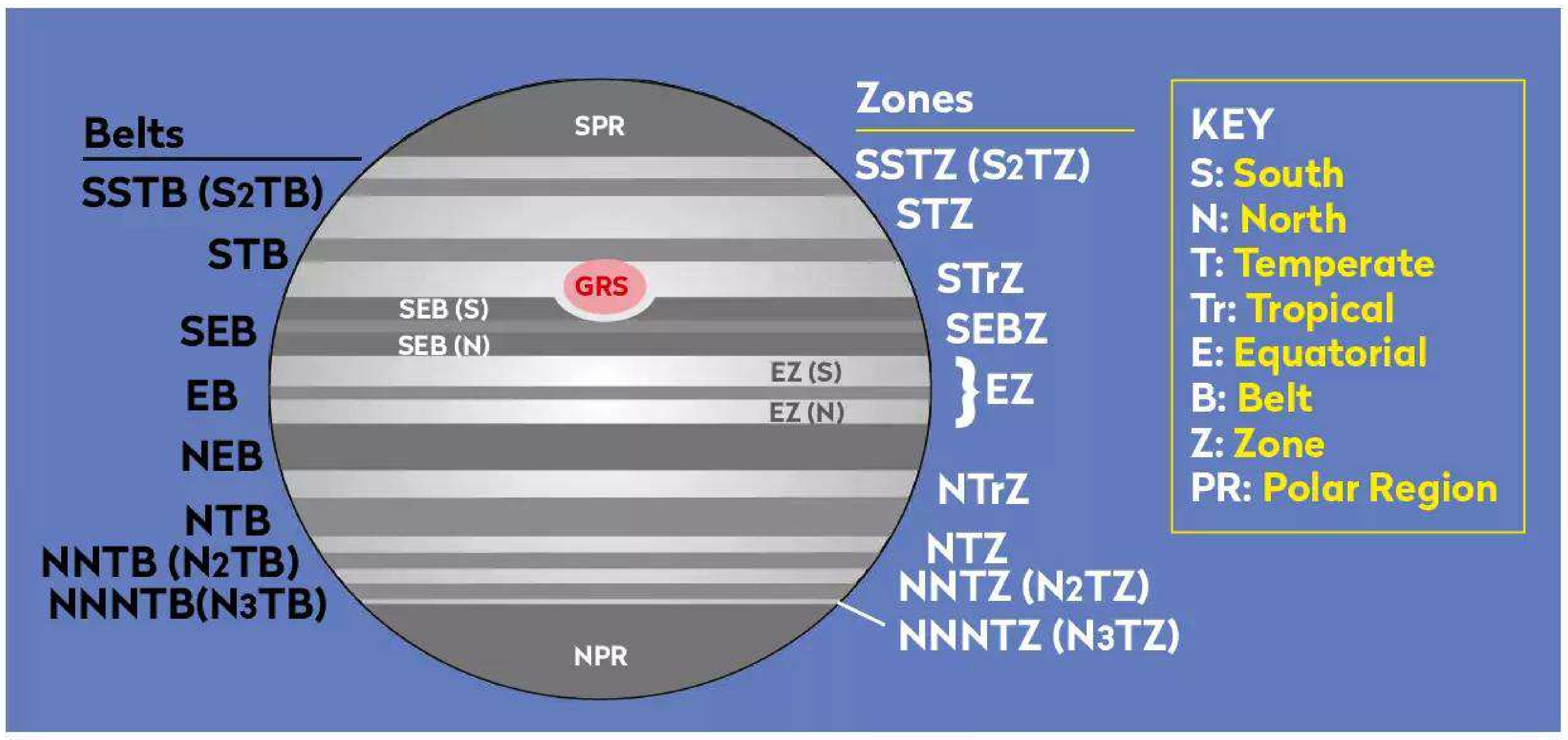
A small scope brings Jupiter to life. Here, it's essential to give your eye time to get used to the view. First and foremost, look at the shape of Jupiter's disc and whether you can see any dark belts crossing it. Jupiter is 11 times larger than Earth and amazingly you could fit a little over 1,300 Earths inside this gas giant. It spins rapidly, one Jovian day a fraction shy of 10 hours. Consequently, Jupiter appears to bulge around its equator, which is something easy to see through a small scope. Its equatorial radius is 71,492km compared to 66,854 in the polar direction.

As you get used to the view, two prominent dark belts appear crossing Jupiter's disc either side of its equator. These are known as the South Equatorial Belt

Venus (right), Jupiter (left) and Mars (upper right of Jupiter) in conjunction during October 2015


The view of Jupiter you'd see with a small telescope (image taken with a smartphone through a telescope eyepiece)

ALL PICTURES: PETE LAWRENCE


Belts
SSTB (S2TB)
STB
SEB
EB
NEB
NTB
NNTB (N2TB)
NNNTB(N3TB)
SPR
GRS
SEB (S)
SEB (N)
EZ (S)
EZ (N)
NPR
Zones
SSTZ (S2TZ)
STZ
STrZ
SEBZ
EZ
NTrZ
NTZ
NNTZ (N2TZ)
NNNTZ (N3TZ)
KEY
S: South
N: North
T: Temperate
Tr: Tropical
E: Equatorial
B: Belt
Z: Zone
PR: Polar Region

▲ Jupiter has many belts and zones, some easier to see than others

(SEB) and North Equatorial Belt (NEB). Using a small scope, once you've seen these, move on to try and find the darker polar regions. Medium to large scopes may reveal additional belts and zones in between a polar region and its nearest equatorial belt, but be aware that these can sometimes be difficult to clearly identify.

Jupiter's SEB has an interloper in the form of the Great Red Spot (GRS), a persistent storm system which sits within a scalloped region in the southern edge of the SEB, known as the GRS Hollow. Over recent years the GRS has shrunk longitudinally. Measuring the GRS's width is something that can be done using a technique known as transit timing. When the GRS is visible, record when its preceding (leading) edge touches the planet's central meridian; an imaginary line running between the poles.

Record the time the following edge of the GRS reaches the central meridian too. Using a program such as the freeware WinJupos (**https://jupos.org/gh/download.htm**), dial in the date and times of your observations and record the system II longitudes (L2) for each. System I longitudes (L1) apply to the equatorial zone (+7 to -7°), L2 applies to everything else. Work out how many degrees of longitude the GRS spans by subtracting the first value from the second. Finally, multiply the number of degrees by 1,187 to get the width of the GRS in kilometres.

Those with larger instruments may notice light and dark patches along or within belts and zones. These atmospheric features may be tracked in a similar way. Recording the longitude of each feature allows you to graph their movement in longitude over time, creating what's known as a drift chart.

The Jovian Moons

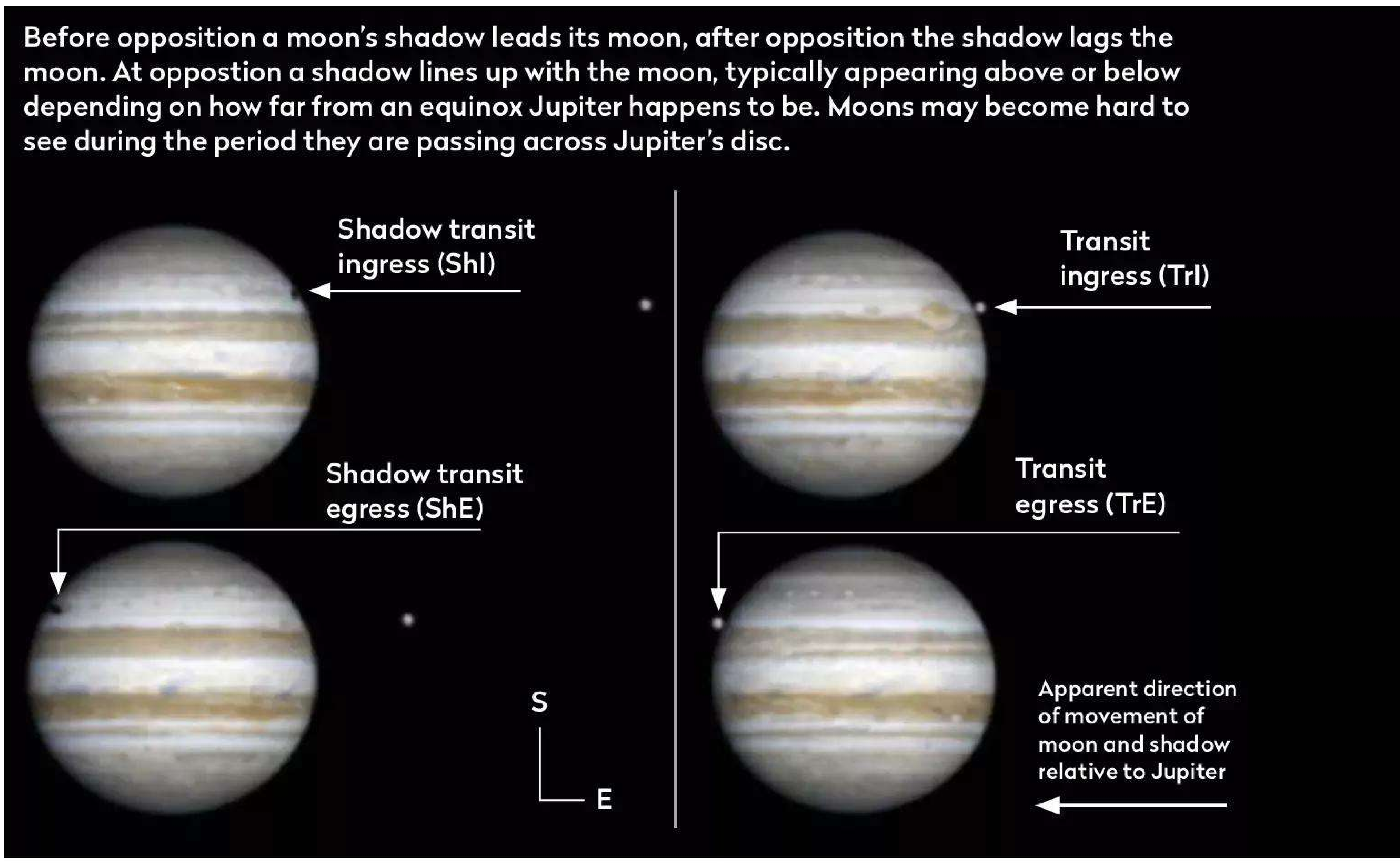
At the last count, Jupiter has 95 officially recognised moons, only four being easily visible through smaller scopes. They are fascinating to watch as they dance back and forth each side of the planet's disc and at times may also appear to interact with Jupiter. There are a whole range of interaction events to observe and it's interesting to try and record each type for each moon. Doing this for Io and Europa isn't hard because of their rapid orbits; 1.76 days for Io, 3.52 days for Europa (twice Io). Ganymede's orbit is slower at 7.16 days (twice Europa), so catching its interactions is trickier, especially as they have to occur when Jupiter is above the horizon and visible!

Callisto (16.69 days) is a whole different story because Jupiter's small axial tilt means it and its shadow miss Jupiter's globe completely for many months. However, when Jupiter is near an equinox, as is currently the case, interactions can be seen. We've mentioned a number of these throughout this Yearbook, something we'll follow up in the monthly magazine as well.

How did you do?

How many of the listed events from conjunctions to moon events were you able to record?

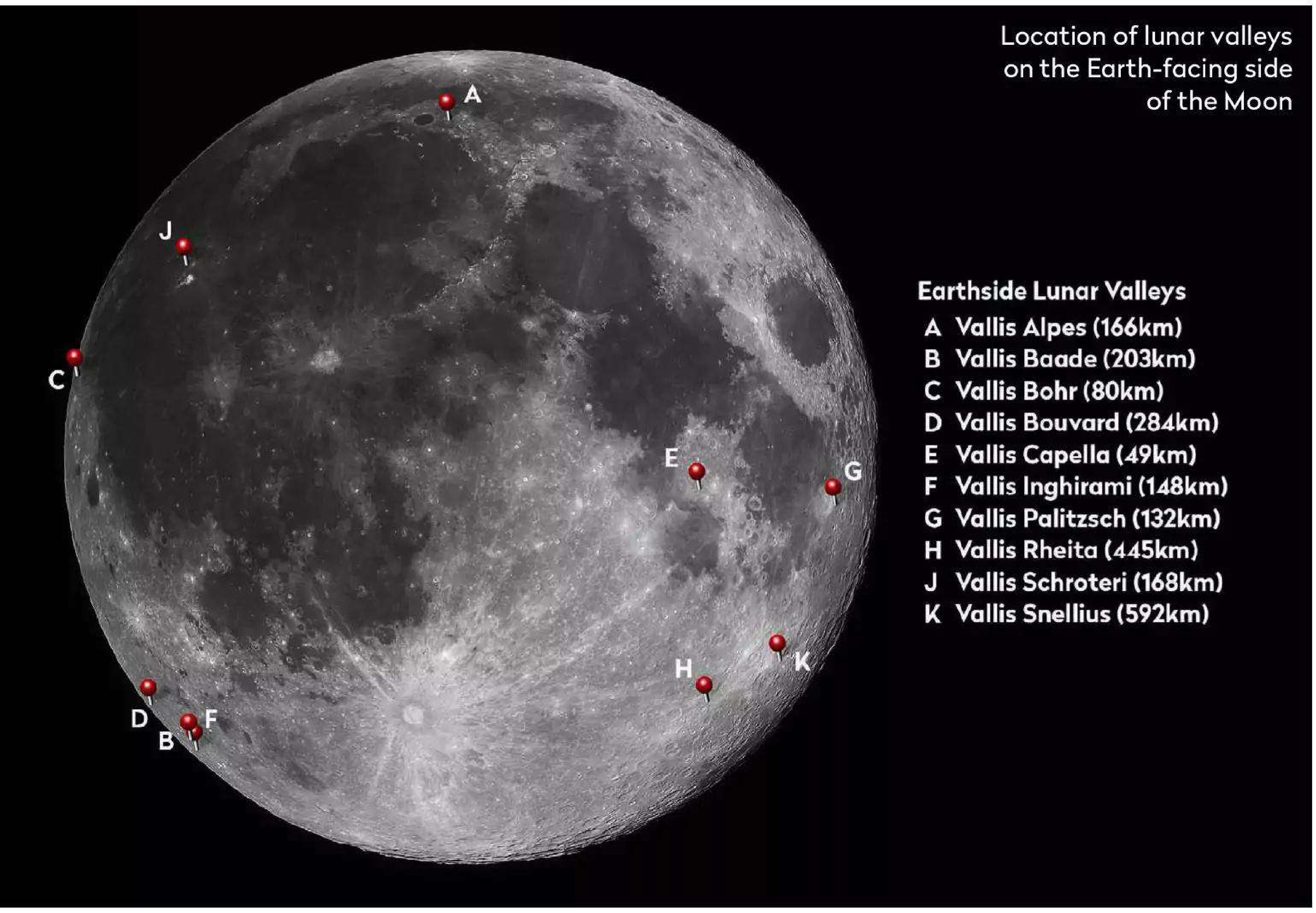
▼ Transit and shadow transit events. It's also possible to see more than one moon and more than one shadow transiting together


Before opposition a moon's shadow leads its moon, after opposition the shadow lags the moon. At oppostion a shadow lines up with the moon, typically appearing above or below depending on how far from an equinox Jupiter happens to be. Moons may become hard to see during the period they are passing across Jupiter's disc.

Shadow transit ingress (ShI)
Transit ingress (TrI)
Shadow transit egress (ShE)
Transit egress (TrE)
S
E
Apparent direction of moon and shadow relative to Jupiter

Project 2: View the Moon's valleys

Track down these spectacular and varied lunar features across the year



Location of lunar valleys on the Earth-facing side of the Moon

Earthside Lunar Valleys

A Vallis Alpes (166km)
B Vallis Baade (203km)
C Vallis Bohr (80km)
D Vallis Bouvard (284km)
E Vallis Capella (49km)
F Vallis Inghirami (148km)
G Vallis Palitzsch (132km)
H Vallis Rheita (445km)
J Vallis Schroteri (168km)
K Vallis Snellius (592km)

The Moon is a favourite object to look at through a telescope. Of all the other objects we can see apart from Earth, it's the only one with a rocky surface which we can see intricate detail on. The closest second is Mars, but that's too far away to see the sort of geological features we see on the Moon. In addition, each lunar month provides us with a roughly two-week period per feature in which it can be observed under changing light conditions. These are most dramatic when the terminator – the shadow line between lunar night and day – is nearby.

Relief features such as mountains, valleys, craters, and so on all benefit from shadow. As the Sun creeps over the horizon for a particular feature, or is close to setting, oblique lighting exaggerates the shadows making lumps and bumps appear far more dramatic than they actually are. These are the times when the terminator is nearby. Having said this, shadows associated with mountains and valleys can also be due to them being physically impressive in their own right.

Lunar valleys come in all shapes and sizes and can result from several different formation mechanisms. As you might expect, lunar geology is the most common mechanism, but there are other ways they can form too. Massive impacts that create giant basins or large craters may throw lunar material away from the impact zone, which can then impact the surface to cause secondary impact features. If the ejected material fragments along the way, this can result in chains of impacts which form pseudo valleys, a consequence of the impact craters creating a continuous linear chain.

Two excellent examples lie near the Moon's eastern limb in the form of Vallis Rheita and Vallis Snellius, the latter is the Moon's longest valley at 592km. Both are examples of long crater chains. Looked at from above, their lines converge at Mare Nectaris giving a strong indication where they came from.

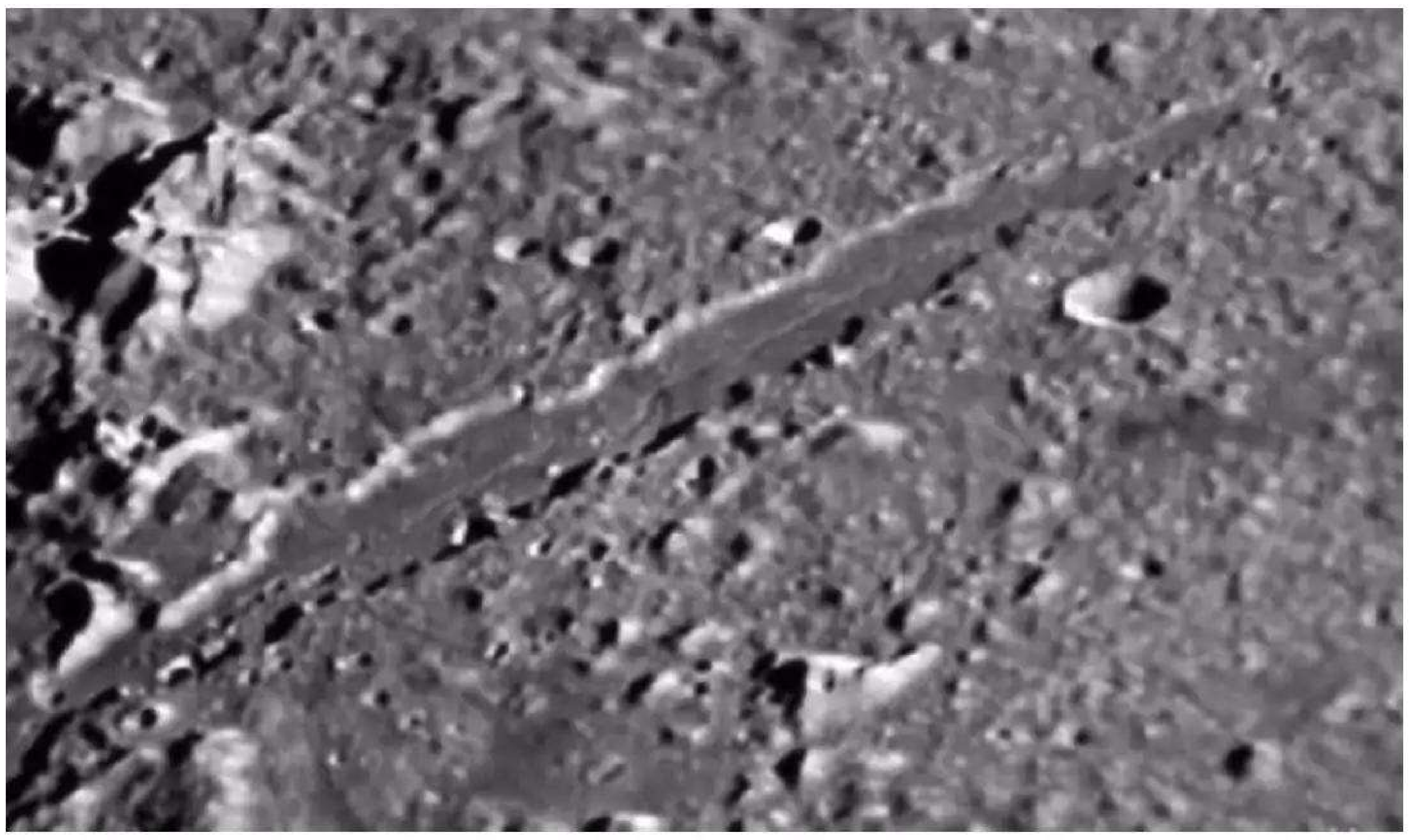
Vallis Snellius is heavily eroded and tricky to pick out, as it passes from 83km Snellius in a line between 177km Petavius and 126km Furnerius. The 500km Vallis Rheita is much clearer, best seen four days after new Moon and three days after full Moon.

Crater chains

This multi-impact mechanism sometimes produces crater chains where the impacting fragments have moved too far apart to appear contiguous and the resulting 'valley' isn't true. Such chains are known as

▼ The multiple impacts responsible for Catena Abulfeda appear largely separate from one another

ALL PICTURES: PETE LAWRENCE



▲ Vallis Alpes showing the narrow rille running down its centre, a feature 600-700m in width

The wonderful snaking form of Vallis Schroteri which can be found near the bright crater Aristarchus (lower left)

catena, and excellent examples include 210km Catena Abulfeda and 50km Catena Davy, the latter being small but beautifully presented as it crosses the flat surface of 70km Davy Y. Although not strictly valleys, these are very impressive under the right illumination.

The most spectacular lunar valley seen from Earth is most probably an example of a 'graben'; a section of the lunar surface which has fallen between two fault lines. The feature we're talking about is Vallis Alpes the Alpine Valley, linking the northeast portion of Mare Imbrium with Mare Frigoris further north and running a distance of 166km. A small telescope will show it appearing like a straight 'road' between both mares. It's also easy to photograph. Vallis Alpes holds a secret which is a very challenging feature to see visually and to image. Running centrally along the floor of Vallis Alpes is a crack 197km long, but just 600-700 metres in width. Best suited for high-resolution imaging, it can be a challenging feature to resolve.

Sadly, a number of impressive valleys are not well presented to Earth, sitting too close to either the eastern or western limbs. This is certainly the case for 203km Vallis Baade, 284km Vallis Bouvard and 148km Vallis Inghirami, which are linked with the formation of the libration locked Orientale Basin.

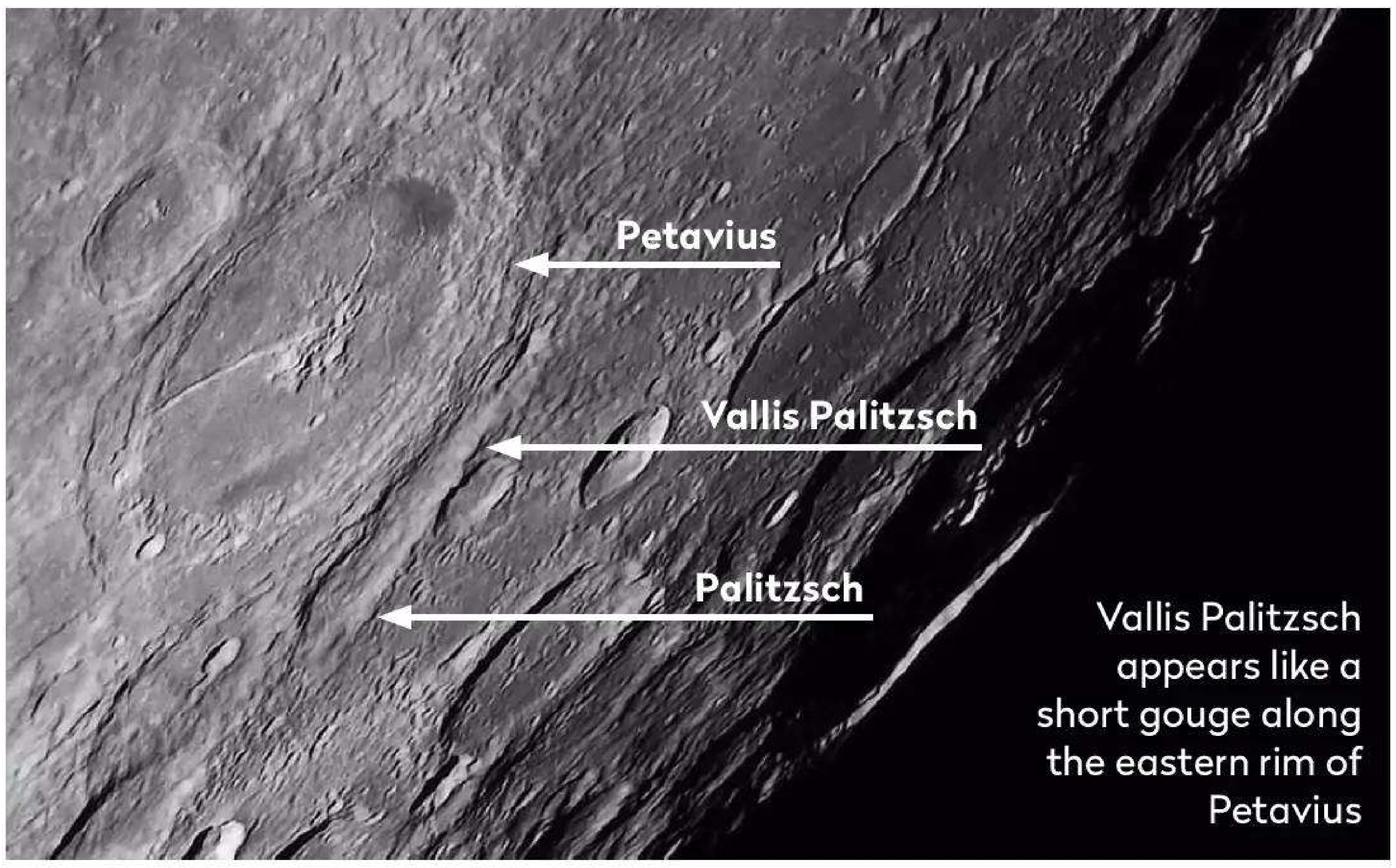
A shorter but better presented valley is available in the form of 168km Vallis Schroteri, which is located near to the bright crater Aristarchus. Unlike the other examples mentioned, this one isn't in a straight line, being an example of a sinuous rille, the largest example of this type of feature on the Moon. Believed to be volcanic in origin, Vallis Schroteri is widest at the start, a position marked by a 6km crater 25km north of 35km Herodotus. This wide start to the valley has been nick-named the 'Cobra's Head'. It then winds its way north, turning northwest for a while before veering round to a southwest direction, its entire length contained on the elevated platform known as the Aristarchus Plateau.

Vallis Capella appears to run for around 200km and is well presented as well. It appears to spear 50km Capella, which is located immediately north of Mare Nectaris, running northwest to southeast through the distinctive crater. Unlike Vallis Snellius and Vallis Rheita, Vallis Capella runs at a tangent to the edge of Mare Nectaris.

Not all valleys are long. Vallis Palitzsch, located adjacent to the eastern rim of 177km Petavius, is an odd example of a valley just 132km in length, but this is only if you include 41km Palitzsch which forms the southern end of the valley.

How did you do?

We've marked the position of a number of lunar valleys, how many have you seen?



Vallis Palitzsch appears like a short gouge along the eastern rim of Petavius

Project 3: Capture the Ringed Planet

Saturn is at equinox, opening a period when infrequent moon events become visible

Saturn as it appeared on 17 March 2009 when its rings were very narrow, as will be the case in 2025

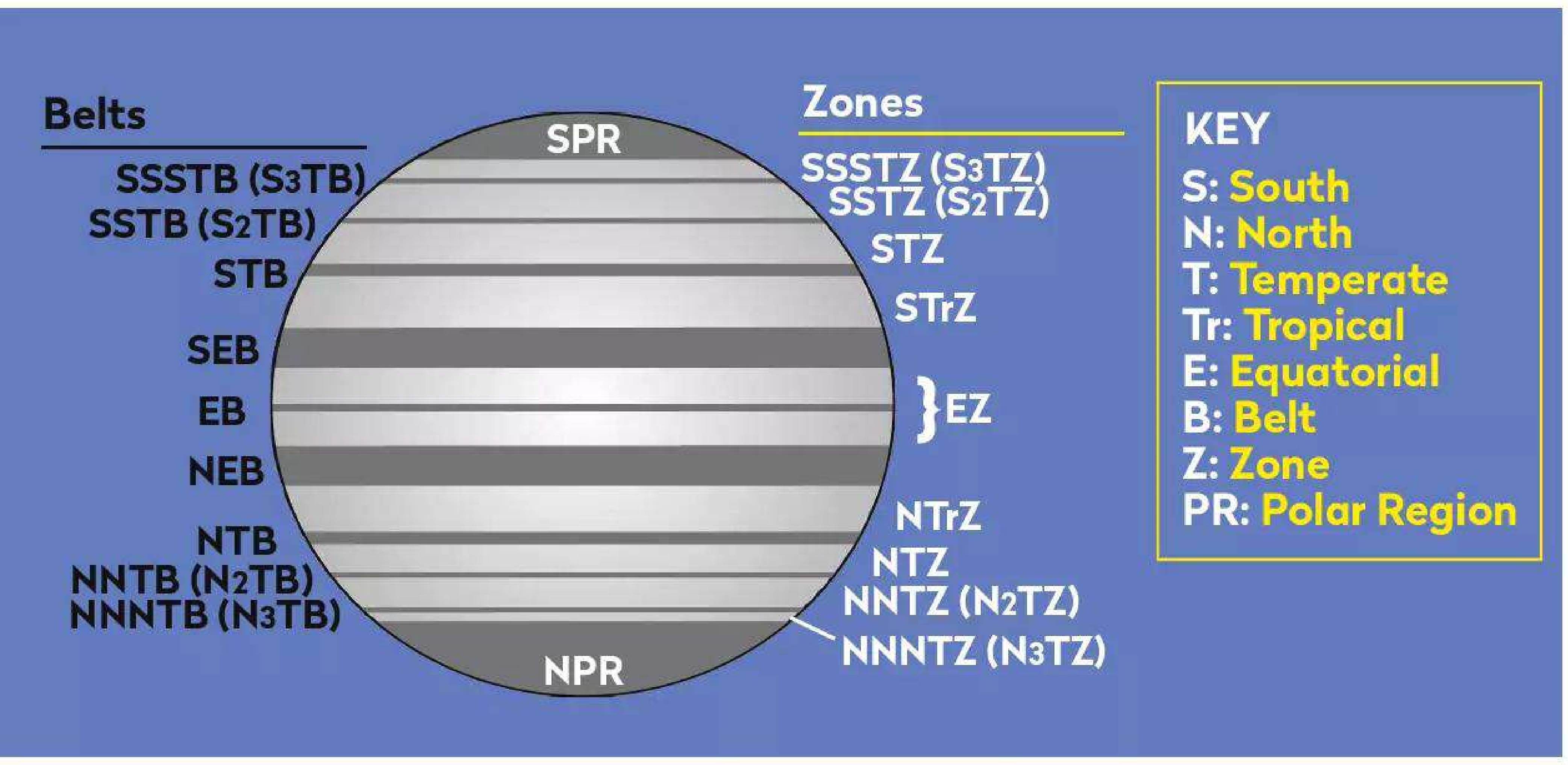
ALL PICTURES: PETE LAWRENCE

Saturn has the largest number of moons in the Solar System, 146 at the last count. Many of these aren't visible to amateurs, but there is a decent number which can be tracked down. These range from the easy eighth magnitude Titan, to the elusively faint Phoebe, marginally brighter than mag. +17! Fortunately, the ones in between cover the whole spectrum of easy to difficult, so there's something for everybody.

Saturn, like Jupiter is a gas giant, but its atmosphere appears less dynamic when viewed through a telescope. It's many subtle belts and zones are labelled as with Jupiter, and it can be hard to pick out the lesser ones, too. Although the atmosphere appears more muted, outbreaks of activity do occur. The most common anomalous features are typically bright storms which can appear as whitish spots in Saturn's atmosphere. If they are long lived, they will sometimes elongate into a feature of enormous complexity, dragged around by the planet's fast 10.5-hour spin rate.

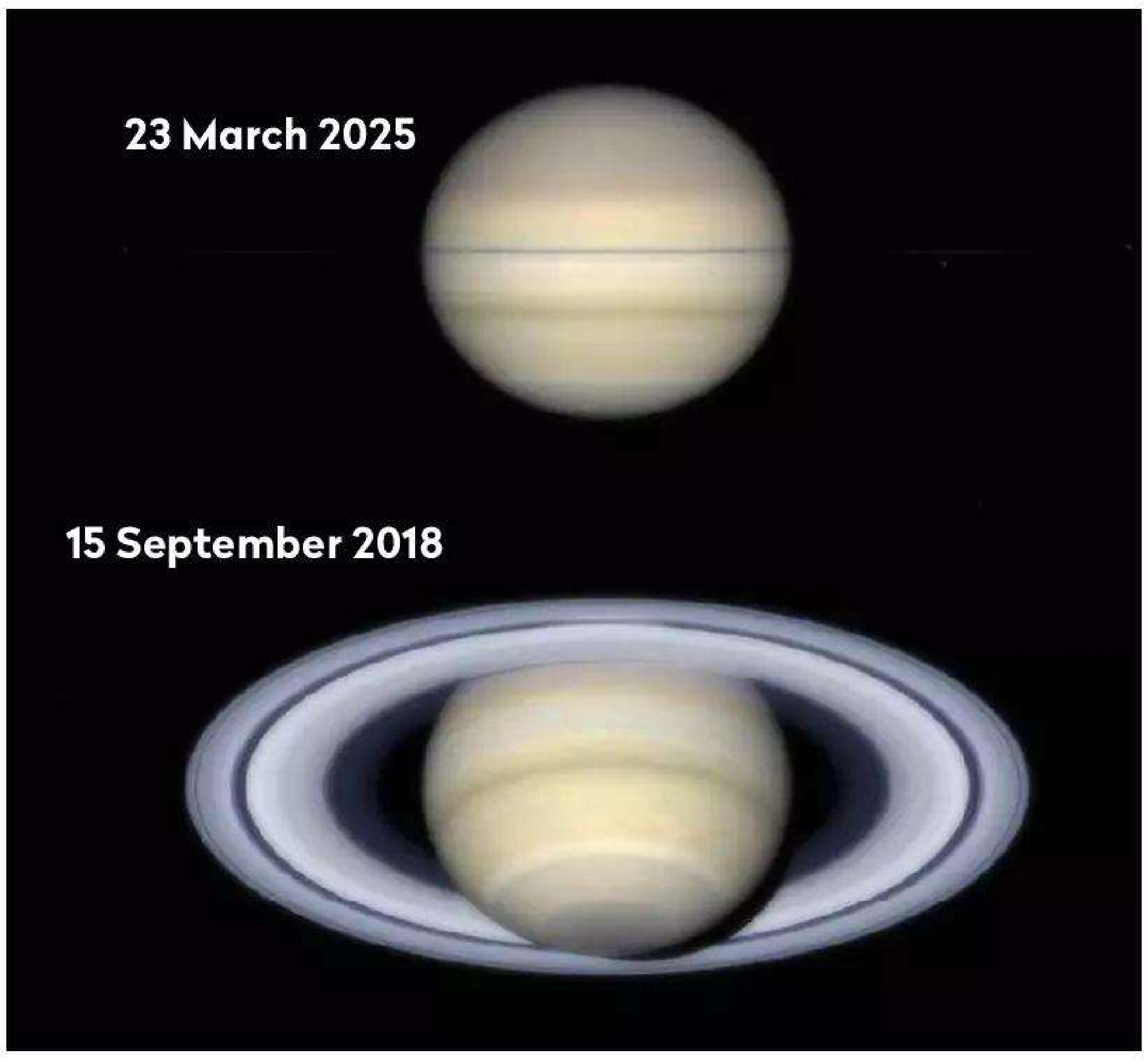
A beautiful example is known as the Dragon Storm, a persistent storm feature observed by the Cassini spacecraft in Saturn's southern hemisphere for many years. Then, in 2010-2011, it was seen to erupt in the northern hemisphere, an extensive eruption that saw it turn into a greatly elongated feature visible by eye.

▼ Like Jupiter, Saturn's globe is covered in belts and zones, however with the Ringed Planet they appear more subtle

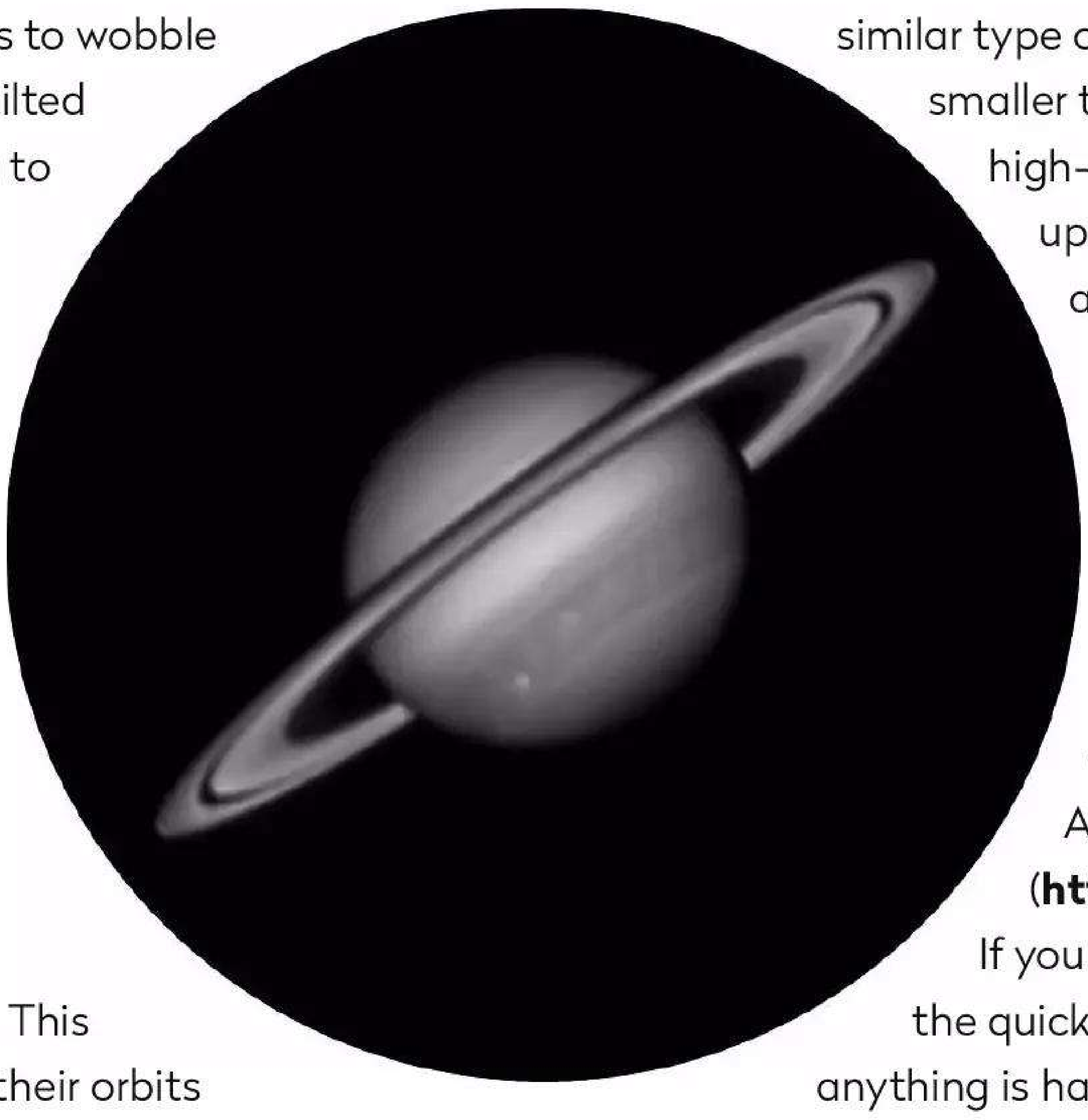


Sideways Saturn

What it lacks for in apparent atmospheric complexity, Saturn makes up for with it's glorious ring system. However, this year, the rings appear very narrow thanks to Saturn passing through an equinox during the first week of May 2025. Saturn's tilt is 26.7°, but approximately every 15 years the planet's tilt relative to the Sun reaches 0.0°; a Saturnian equinox. As it's so far from the Sun and Earth, we too get to see it edge on at such times, but both planet's orbital geometries mean our sideways view is offset from Saturn's actual equinox and we get to see Saturn appearing edge on to us on 23 March 2025.



▲ On 23 March, Saturn will appear edge on from Earth (sadly, too close to the Sun to see), a long way from when it's wide open, as it was in 2018 (tilt angle 26.6°)



▲ Turbulent times in Saturn's northern hemisphere emphasised in a greyscale image taken through a red-imaging filter (with south pointing up)

Throughout the year, Saturn appears to wobble slightly. On 1 January its north pole is tilted towards us by 5.2°, steadily decreasing to 0.0° on 23 March when Earth passes through the plane of Saturn's rings. The tilt angle then continues to increase negatively as it's Saturn's southern pole now tilted towards Earth. On 8 July, Saturn's apparent tilt maxes out at -4.4°, before appearing to decrease again to reach a minimum of -0.5° on 25 November, reaching -1.1° by the end of the year.

Many of Saturn's major moons orbit the planet near to its equatorial plane. This year, if we could see them from Earth, their orbits would also look like very narrow ellipses. As a result, the major moons and their shadows will be able to interact with Saturn during 2025. This gives rise to a flurry of fairly unique events, similar to what can be seen more regularly on Jupiter. Eventually, when the tilt angle recovers to a reasonable value once again, the interactions will largely stop and you'll have to wait 13 or so years to see them start up again.

The most obvious apparent interaction involves Saturn's largest moon Titan. These include Titan and its shadow transiting Saturn, Titan occulted by Saturn, and Titan being eclipsed by Saturn's shadow. There are enough events listed in the Sky Guide (starting on page 37) to hopefully overcome any weather issues.

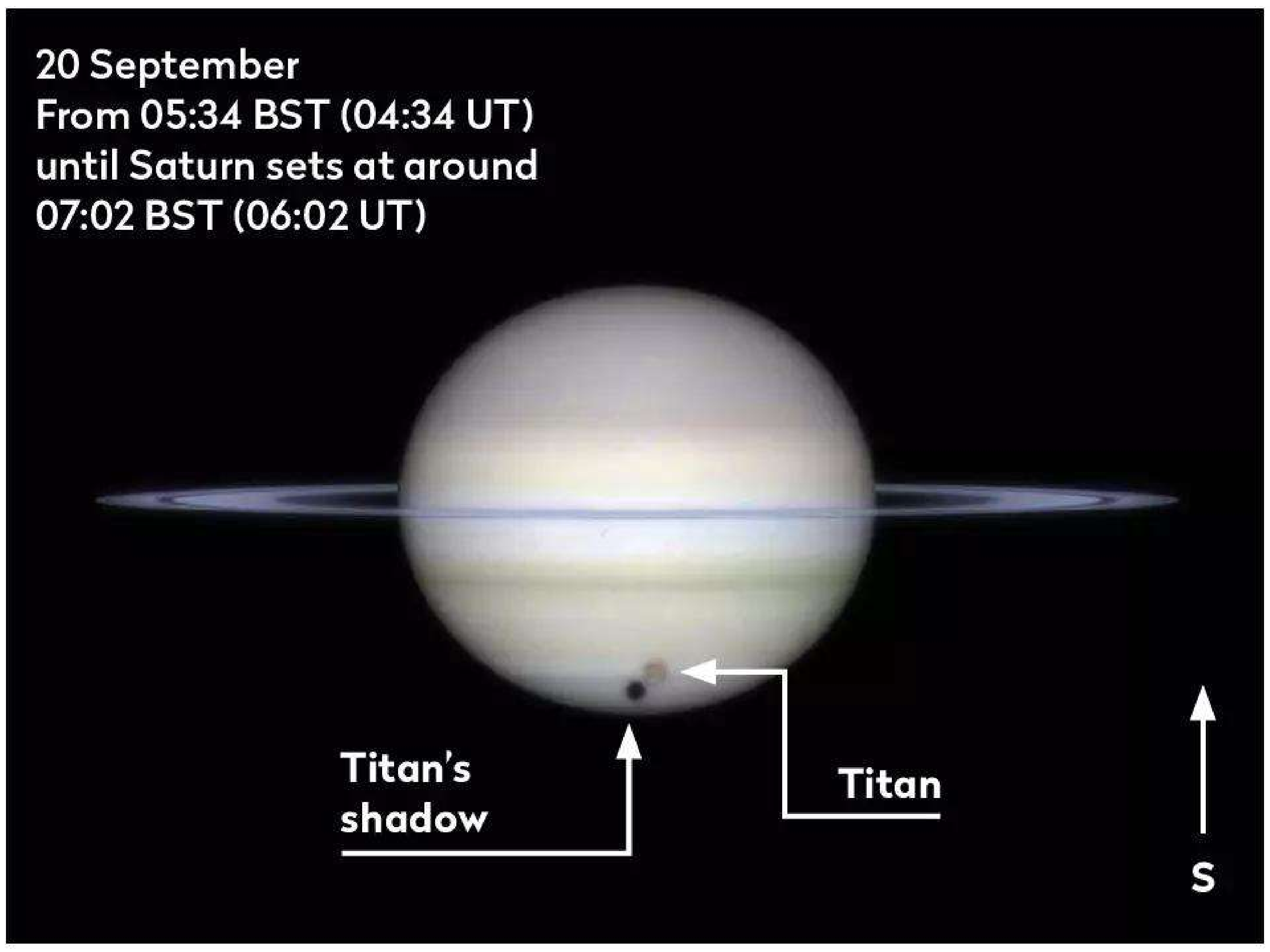
Less obvious are similar interactions by other major but less sizeable moons. Typically, the main contenders here are Tethys, Dione and Rhea. These all show similar type of interactions, but being that much smaller than Titan required larger set-ups or high-resolution planetary imaging set-ups to capture. Be aware that stable atmospheric conditions are a must here too, turbulent seeing being very good at blurring out the tiny shadows.

There are various ways to plan such observations. One of the best is to use the WinJupos application; a free software equivalent of a Swiss Army Knife for planetary observers (**https://jupos.org/gh/download.htm**). If you have a clear night or nights ahead, the quickest way to check to see whether anything is happening is to run the application, under [Program ➔ Celestial body] select Saturn, then go to [Tools ➔ Ephemerides...]. Click [Real time], select the [Graphics] tab and cycle forward in time to see if there's anything happening that evening.

Timings for Titan events aren't ideal at the start of 2025 with many occurring in daylight. However, the forementioned apparent tilt wobble means we get a second chance towards the end of the year. Titan transits then come back on the menu until February 2026 when they end for this Saturnian equinox, before restarting again in around 13 years. Many of these late year events are well timed, giving you a good opportunity to observe and record these rare interactions.

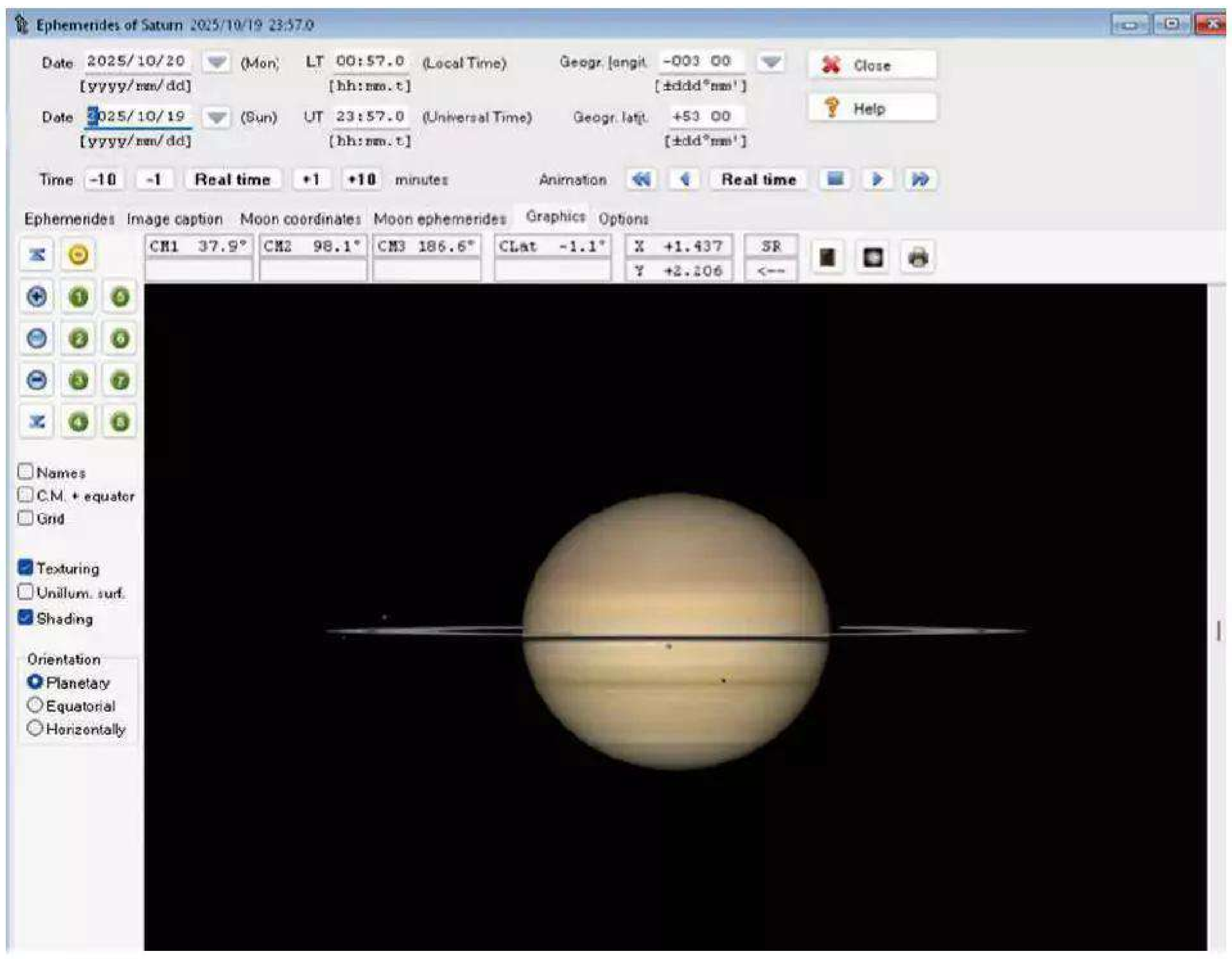
How did you do?

How many Saturn moon interactions have you seen?



20 September
From 05:34 BST (04:34 UT)
until Saturn sets at around
07:02 BST (06:02 UT)

▲ Just one of many interesting events involving Saturn that's visible throughout 2025; you can find more mentioned in the Sky Guide section, starting on page 37



Ephemerides of Saturn 2025/10/19 23:57.0

Date 2025/10/20 [yyyy/mm/dd] (Mon) LT 00:57.0 [hh:mm.t] (Local Time) Geogr. longit. -003 00 [±ddd°mm']

Date 2025/10/19 [yyyy/mm/dd] (Sun) UT 23:57.0 [hh:mm.t] (Universal Time) Geogr. latit. +53 00 [±dd°mm']

CM1 37.9° CM2 98.1° CM3 186.6° CLat -1.1° X +1.437 Y +2.106 SR <--

☐ Names
☐ C.M. + equator
☐ Grid
☑ Texturing
☐ Unillum. surf.
☑ Shading

Orientation
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Close
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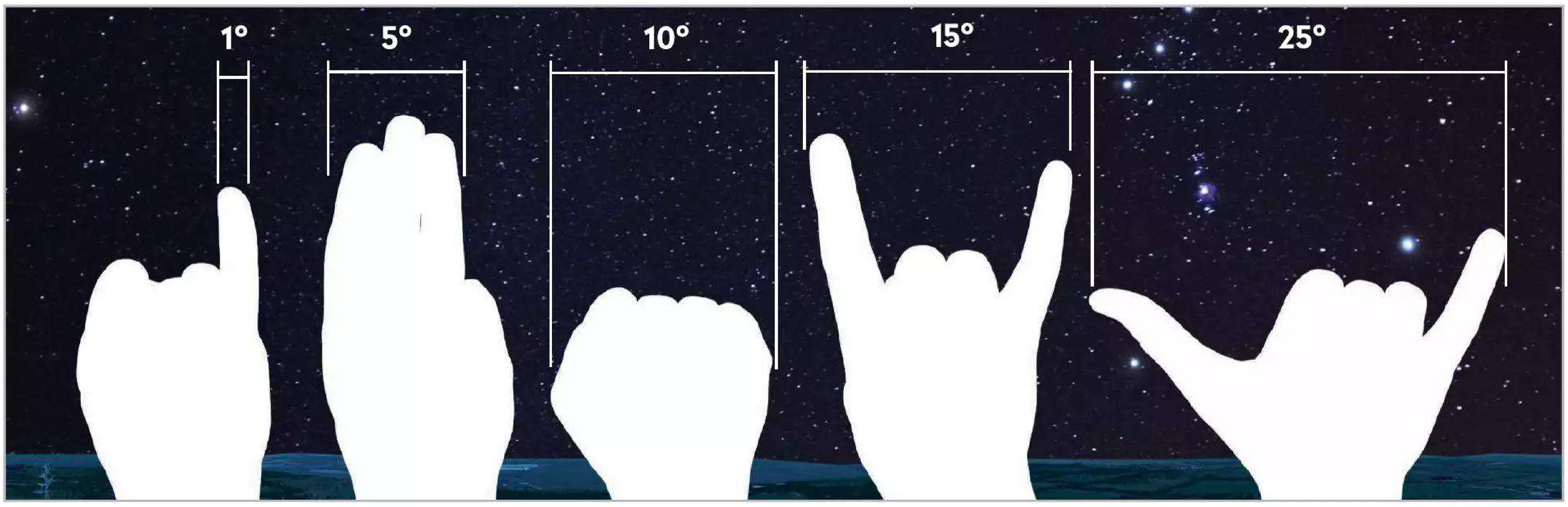
▲ Feature-rich WinJupos is a superb freeware application for giving concise information about the planets and their moons

Skills for stargazers

Star-hopping

Steve Tonkin explains an easy technique to navigate your way around the night sky



▲ With your arm outstretched, use your hand to gauge distances between objects in the sky

If you're a newcomer to the wonderful hobby of astronomy, your first time under a clear sky can be overwhelming.

Fortunately, there's a tried and tested method to turn the bewildering number of stars into a familiar recreation ground, which works in bright and dark skies alike. It's called star-hopping.

What we do is make easily identifiable patterns (called asterisms) from the brightest stars and use these as jumping-off points to locate our desired target objects, and we estimate directions in relation to other stars – for example, "towards that bright yellowish star".

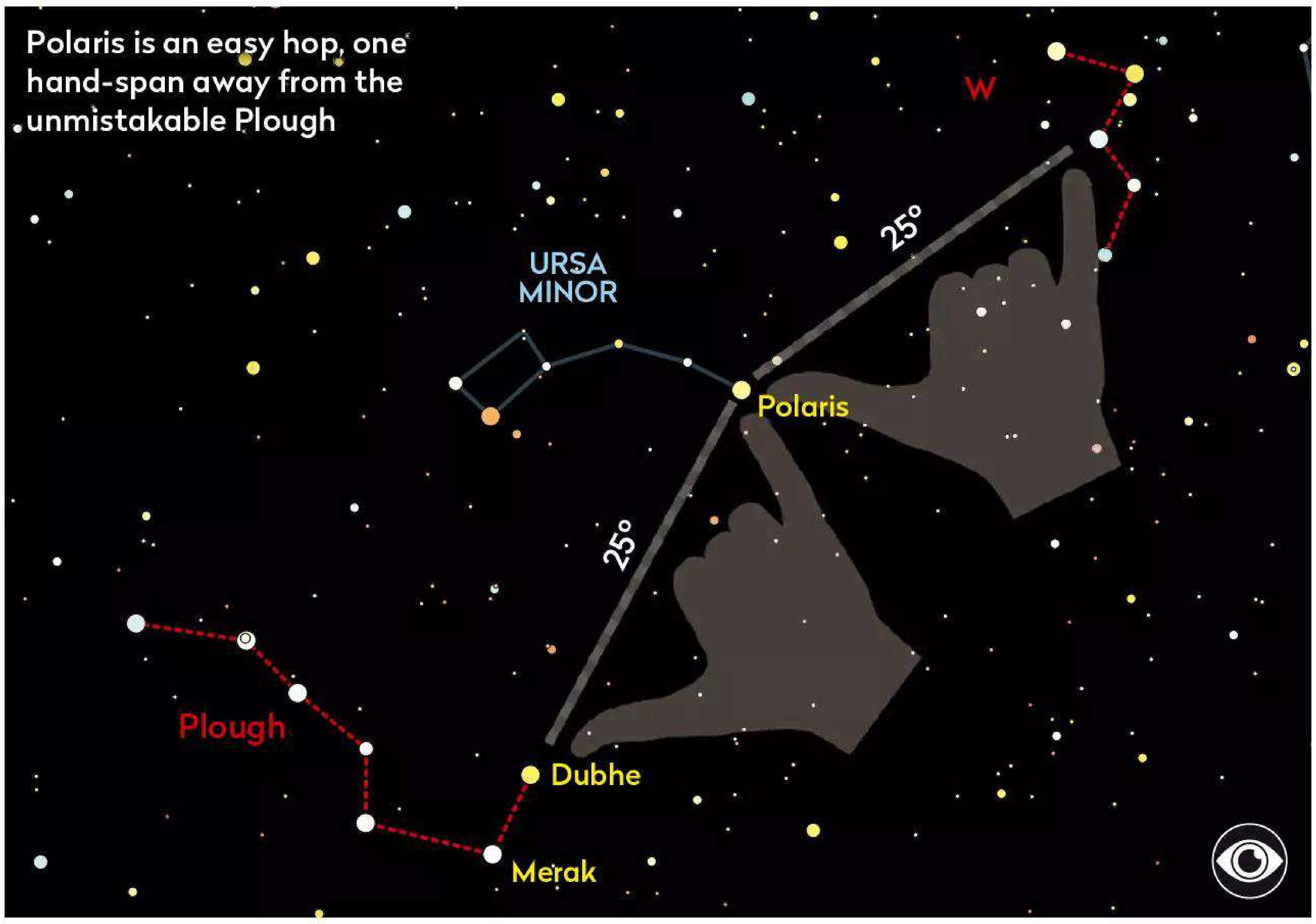
Estimating distances works in much the same way – for example "a third of the way from the lower star to the upper one" or a proportion of the field of view of your binoculars or telescope. Alternatively, if you stretch out your arm, you can use the distance covered by your fist or hand-span to measure out the distance (most of us are more or less similarly proportioned for this purpose). Let's look at four star-hops to help test your skills.

Stephen Tonkin is an experienced binocular astronomer, who writes our monthly Binocular Tour

Star-hop your way to the Pole Star

Polaris is crucial in astronomy, because it marks the position of the North Celestial Pole, the point around which the northern sky seems to revolve, and which is above the north point on the horizon – so that's where we'll begin. We'll use 'the pointers', Merak and Dubhe, in the Plough asterism of Ursa Major. These point directly to the pole star, Polaris, which is slightly more than a hand-span from Dubhe – or, if you prefer, about five times the distance between Merak and Dubhe.

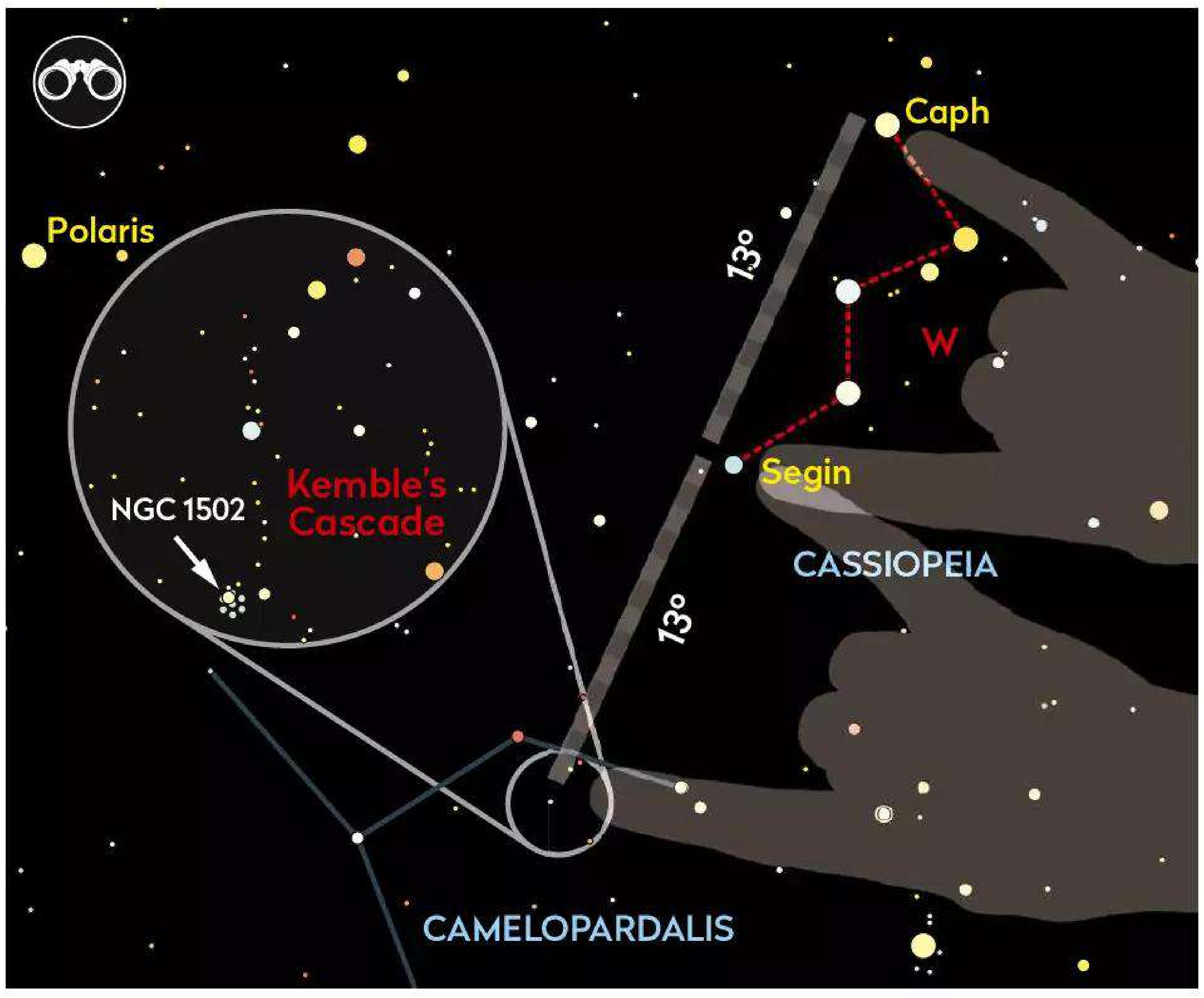
Sometimes, during autumn evenings, for example, the Plough may be close to the horizon and concealed by trees or buildings. In that case, the W-shaped asterism of Cassiopeia will be high in the sky and we can use that instead.


Polaris is an easy hop, one hand-span away from the unmistakable Plough

CHARTS BY PETE LAWRENCE

Hop to the asterism Kemble's Cascade

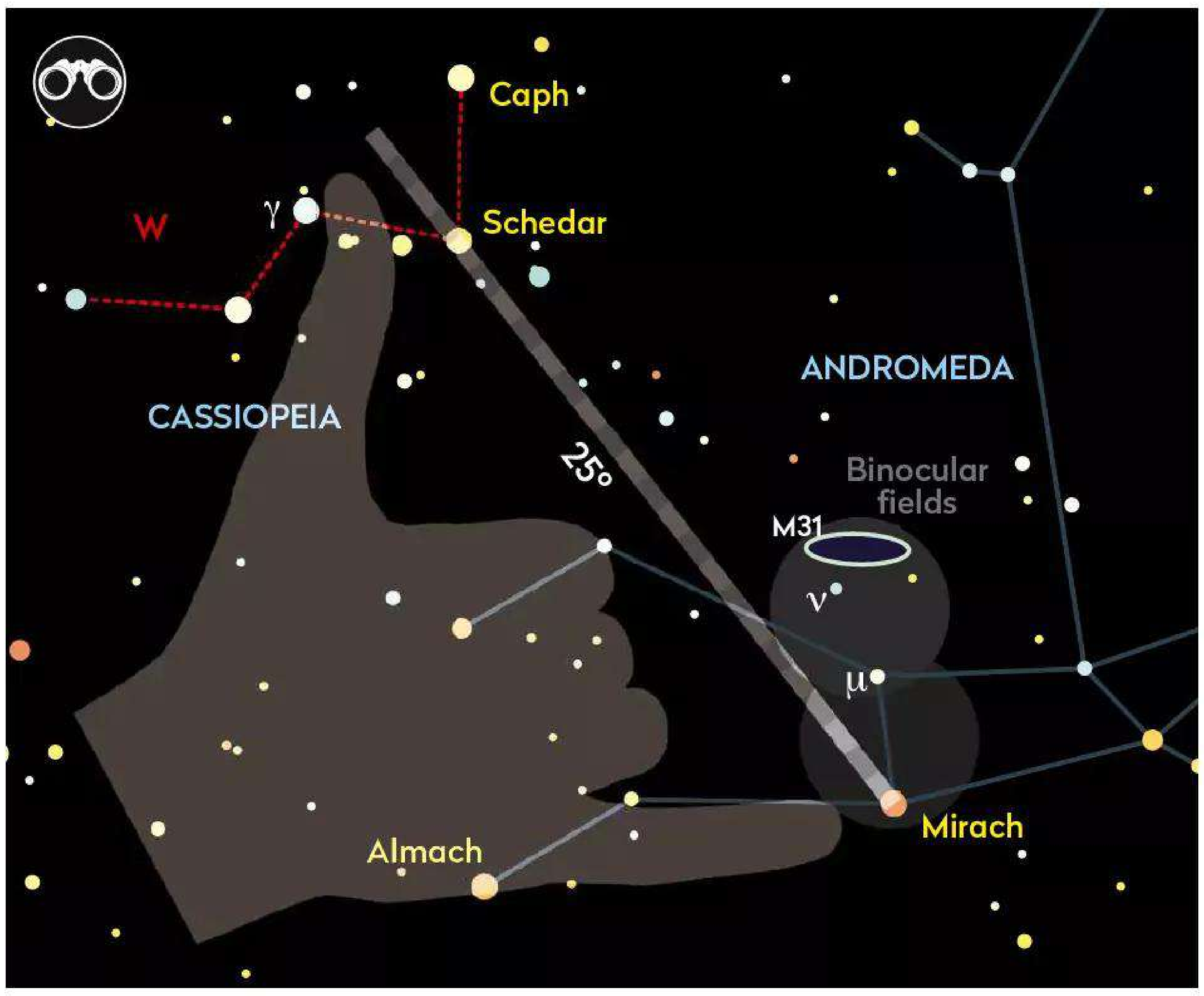
Finding Kemble's Cascade in Camelopardalis with binoculars requires a long star-hop, as there are no nearby bright stars. Find Caph and Segin at either end of the 'W' shape of Cassiopeia. Use the little finger and index finger of one hand to measure the distance between them. Then, without changing the distance between your fingers, locate the point in the sky that's the same distance the other side of Segin in a straight line from Segin and Caph. Keeping your eyes fixed on this point, raise your binoculars and you should see a straight line of eighth and ninth-magnitude stars with a bright mag. +5.0 one in the middle. On autumn evenings it's almost vertical, resembling a ribbon waterfall cascading into the 'splash-pool' of the open cluster NGC 1502.



▲ To get to Kemble's Cascade, measure the distance between the points of Cassiopeia's 'W', then hop on by the same distance again

Hop to the Andromeda Galaxy, M31

The easiest way to find the Andromeda Galaxy, M31, is a two-part star-hop. The first hop locates the star mag. +2.1 Mirach in the constellation of Andromeda, from which we do a second hop. Locate the 'V' of stars made by Caph, Schedar and Gamma Cassiopeiae. Follow the arrow these make to Mirach, around a hand-span away. Now locate Mirach in binoculars: it's distinctly yellow, so is easy to identify. Put it near the southeast edge of your field of view (near the bottom during autumn evenings) and look for the white, mag. +3.9 Mu Andromedae near the other side. Now put Mu where Mirach was and you'll see a fuzzy patch where Mu was. This is the light that has arrived in your eyes 2.5 million years after it left the Andromeda Galaxy.

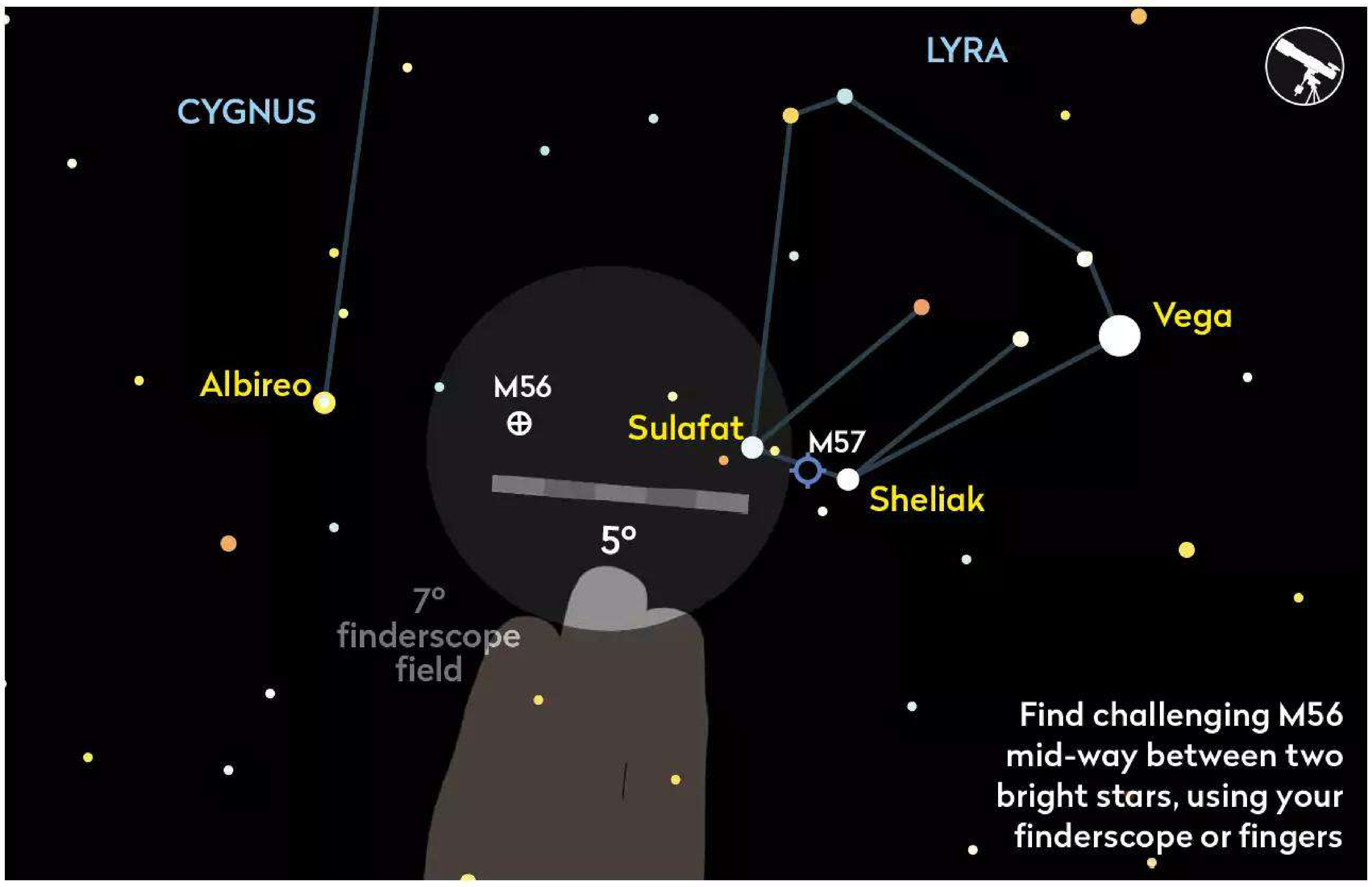


▲ Using your binoculars' field of view as your benchmark, hop from Mirach to Mu, then pivot that same distance to hop from Mu to M31

...and to the globular cluster M56

At mag. +8.4 and only 5 arcminutes in diameter, M56 is a little faint and small for binoculars, so we'll change to a telescope. To find it, first identify mag. +3.1 Albireo, the head of Cygnus, the Swan, and mag. + 3.3 Sulafat in Lyra, the Lyre. M56 lies directly between them, 4.5° from Sulafat.

If your telescope has a finderscope, you can relate this distance to its field of view (a typical 6x30 finder is 7°). Otherwise, you can use the apparent width of your three middle fingers, which is roughly 4.5°. With a low-power eyepiece, use your finder to put you in roughly the right position; M56 will look like a de-focused star. Centre it and swap to a higher-power eyepiece to get more detail.



Find challenging M56 mid-way between two bright stars, using your finderscope or fingers

Master the art of averted vision

Martin Mobberley explains how to see fainter objects than you ever imagined possible

▲ With averted vision you'll see faint targets like the Orion Nebula (above left) and the Andromeda Galaxy (top right) better. For the Blinking Planetary Nebula, NGC 6826 (above right), looking directly at it, you will only see its central star, but if you use averted vision and look to one side, you will see the nebula

If you're new to stargazing, a faint object like C/2022 E3 ZTF, the comet that had us all excited earlier this year, isn't the best target for a first look through a telescope – the chances are you won't see a thing. The eye is a remarkable detector, but to see faint objects like this it helps to understand both its limitations and the tricks you can use to coax the maximum out of its short-exposure capability (unlike a DSLR camera, long exposures aren't an option with the eye).

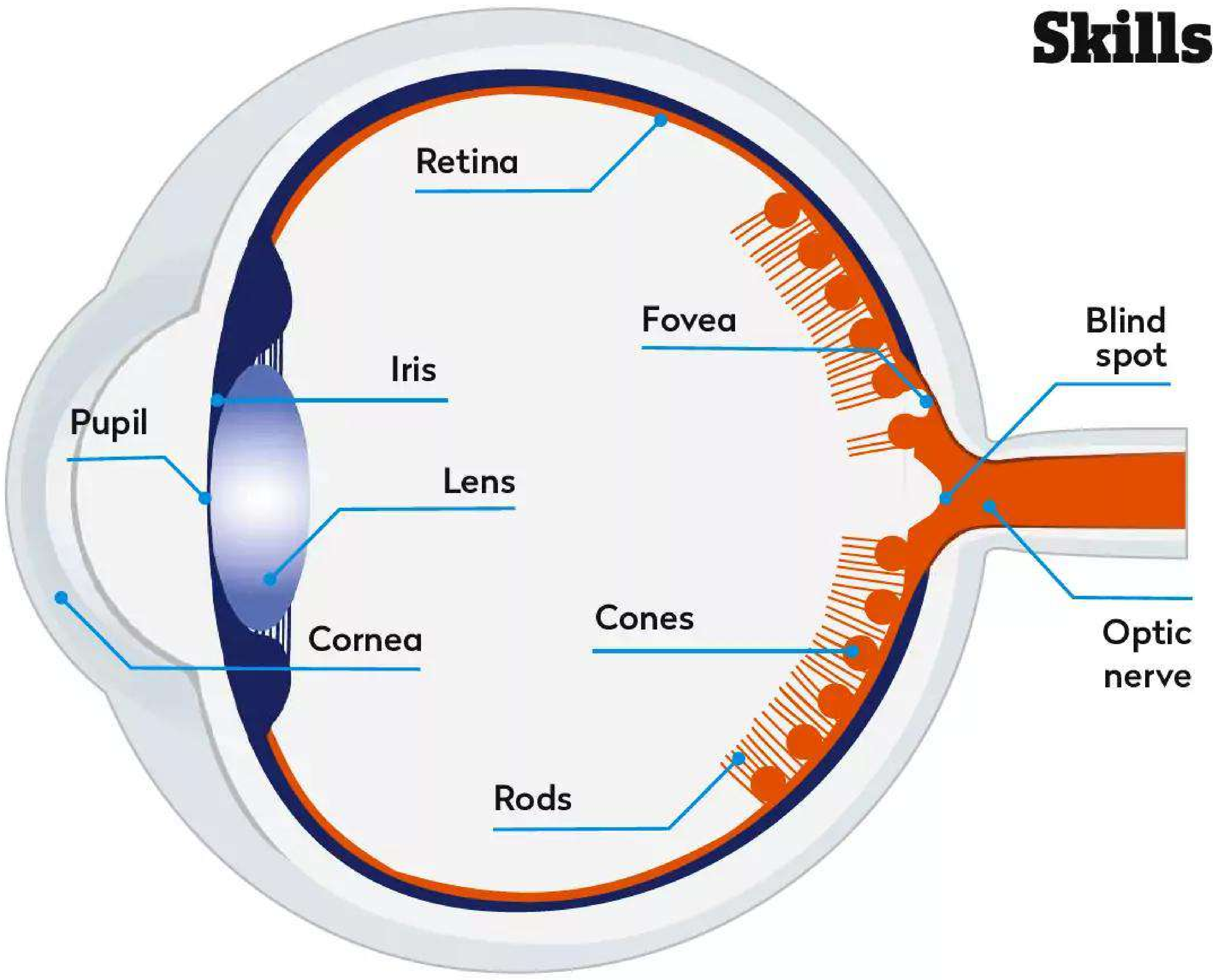
Of course there are other limiting factors. Light pollution, impatience, a poor night for seeing, and not spending long enough dark-adapting your eyes can all play a part, as can using the wrong magnification and not keeping your telescope's optics clean and well-collimated. But by mastering 'averted vision', you can train your eyes to get the most out of your observing nights and use your retina to greatest effect.

The retina is the thin layer of cells that line the back of the eyeball, where light entering from the pupil is converted into signals for the brain. The eye has two types of detector cells within the retina, called rods and cones. Rods are low-light detectors, whereas cones allow full-colour, high-resolution eyesight. The central one degree of the retina, the fovea, is packed with cones which you are using to read this sentence. Your brain creates the illusion that the whole magazine page is sharp, but in fact you are only seeing a few letters at a time at high resolution and in full colour; your eye muscles are swiftly zipping everywhere and creating the illusion.

Find your sensitive side

The electrochemical signals from the retina's detectors travel via neurons, known as ganglion cells, on their way to the brain. In the high-resolution, full-colour retina centre, one ganglion cell connects to one cone. But as you go further out and low-light rods dominate, there may be 100 rod detectors passing their electrochemical signal into just one ganglion cell; it is a case of paralleling up to improve the signal-to-noise ratio.

CEDIC/CHRISTOPH KALTSEIS/CCDGUIDE.COM, BERNHARD GOTTHARDT/CCDGUIDE.COM, BERNHARD HUBL/CCDGUIDE.COM, SOLAR22/ISTOCK/GETTY IMAGES, STEVE MARSH



◀ At the back of the eye lies the retina, lined with millions of light-sensing cells, rods and cones (shown here at many times actual size). These convert photons to electrochemical signals that travel along the optic nerve to the brain, where they're processed into images

With so many detectors bundled together, resolution suffers badly. While the foveal cones can resolve a 60th of a degree (one arcminute), the bundled rod system, well away from the centre, might only resolve 20 arcminutes; that's not much finer than the size of the Moon seen with the naked eye.

The good news is that there is an optimum, ultra-sensitive, rod-packed region of the retina that you can bring into play. Here at this crucial point, the eye is about four astronomical magnitudes (40 times) more sensitive than at its centre.

To get to this sensitive area, you have to look to one side of the faint astronomical object you're trying to see: place the object you're looking at roughly 8° to 16° away from the eye's centre; 12° is a good average value for the best part. At first this will seem incredibly difficult, but it will improve with practice.

This 12° offset should be arranged so that you appear to place the object nearer to your nose. The reason for this is that the eye has a blind spot where the optic nerve leaves the retina and this blind spot is on the other side, away from the nose. Physically, it isn't – the eye's lens turns everything upside down, but we are looking at how it feels here and not how it actually is.

Keep it dark

Of course, when you first go outside and look through the eyepiece, you probably won't see anything. This is because your eyes aren't dark adapted. When the human eye is plunged into darkness, two things happen. Firstly, the pupil dilates (expands) to its maximum diameter. The second thing is that the amount of the chemical rhodopsin in the retina increases dramatically, many thousand-fold. So the combined effects of rhodopsin and using averted vision amounts to over 100,000 times more sensitivity than your central vision had in a fully-illuminated room before you stepped outdoors.

Dark adaptation – that is, waiting for the rhodopsin to do its job – cannot be rushed. You need to wait 40 minutes or more to feel the full effect. So, if you are planning to observe a number of faint objects, say the Orion Nebula, the Andromeda Galaxy or even the Blinking Planetary Nebula, save the faintest ones until the very last – you won't be disappointed.

Martin Mobberley is an author and lifelong amateur astronomer, and served as BAA president in 1997–99

Other ways to see faint targets

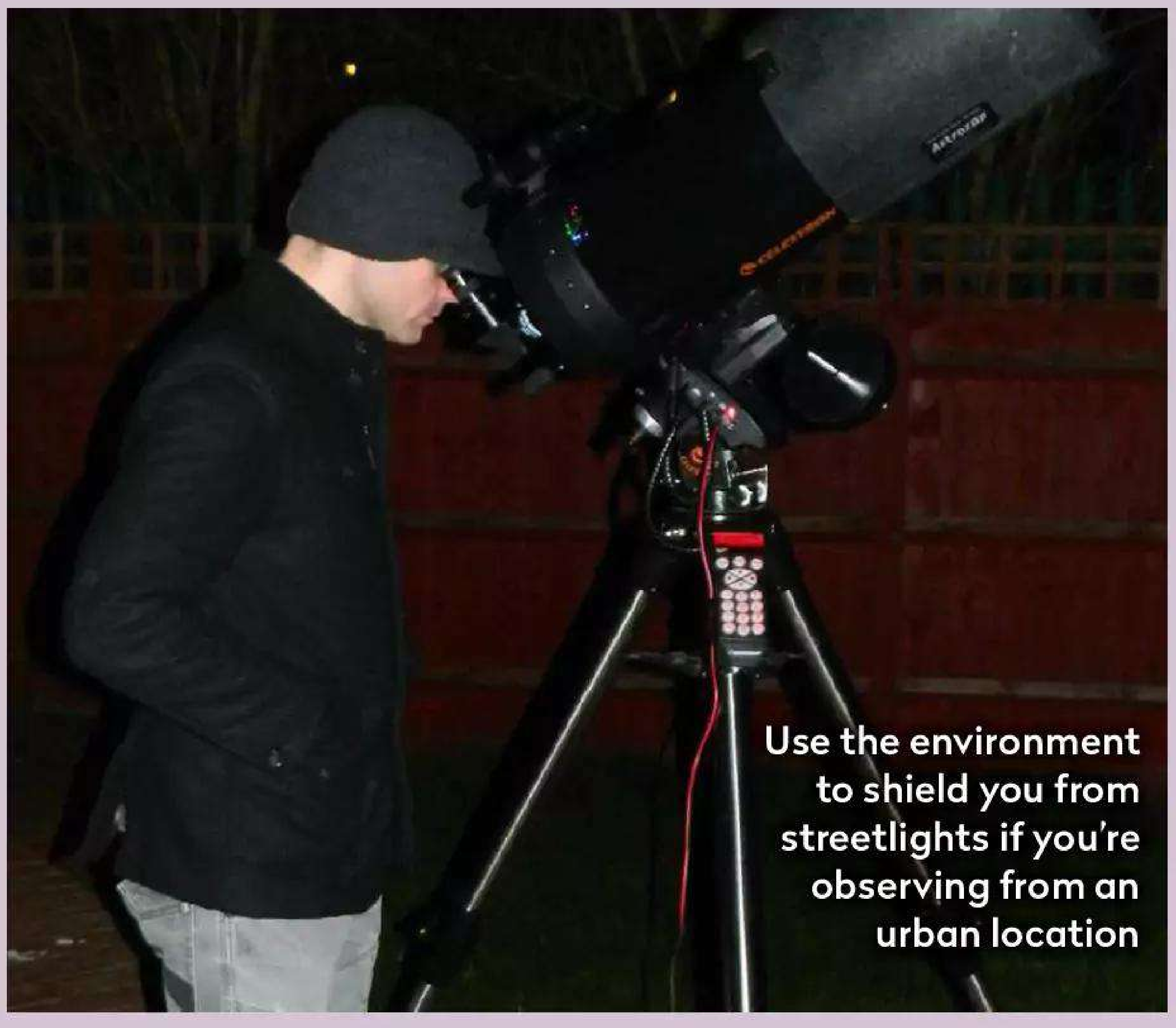
As well as averted vision, try these steps to help you observe dim targets in the night sky

Telescope
Check your telescope is in good working order, with clean optics. If it's a reflector, make sure that its mirrorrs are accurately collimated.

Eyepieces
High-quality eyepieces will maximise your chances of seeing faint objects. A rubber eyeguard will exclude stray light.

Weather check
The best crystal-clear nights often come when a cold front or a northerly air stream moves down the country. Check the Met Office's weather maps for the latest forecast.

Dark site
Darker skies are better, of course, but if yours aren't you can block out streetlights by carefully positioning your scope or using fence panels as shields.



Use the environment to shield you from streetlights if you're observing from an urban location

Skills for stargazers

Predict an aurora display

Mary McIntyre's top tips for taking the guesswork out of catching the amazing natural spectacle

▲ Mary's photographs of the aurora taken in Oxfordshire in June 2015 (left) and February 2023 (right)

Seeing the aurora borealis (Northern Lights) or aurora australis (Southern Lights) is at the top of many people's bucket lists, but you don't need to travel to the polar regions to see or photograph a display. Armed with forecasting data, you can be ready and waiting when the conditions are right.

On 1 September 1859, Richard Carrington and Richard Hodgson recorded the first visual observation of a solar flare. Less than 18 hours later, the largest geomagnetic storm ever recorded, the Carrington Event, began. Aurorae were seen all around the world, even in equatorial locations. It was the first definitive proof that aurorae are directly linked to solar activity.

When charged particles from the Sun, the solar wind, interact with molecules in our atmosphere, they glow. Earth's magnetic field channels the particles down towards the polar regions, which is why aurorae are usually seen within the Arctic and Antarctic Circles. Solar flares and their associated coronal mass ejections (CMEs) can send much higher energy solar wind towards Earth, causing geomagnetic storms.

It's not only CMEs that cause them. Disruptions in the Sun's magnetic field can lead to 'coronal holes' that allow faster moving solar wind to stream out from the Sun, which can lead to mid-latitude aurorae. As we are currently close to the maximum period of activity in the Sun's solar cycle, there have been a lot of mid-latitude aurora displays already this year.

Space weather is now monitored constantly and scientists are getting better at forecasting aurorae.

ALL PICTURES: MARY MCINTYRE

Aurora alert sites

- ▶ **sdo.gsfc.nasa.gov/data** The Solar Dynamics Observatory website lets you study photos of the Sun and monitor solar activity
- ▶ **flareaware.com** gives live updates of solar flares and CMEs, as well as geomagnetic storm predictions and alerts
- ▶ **www.youtube.com/@TamithaSkov** Dr Tamitha Skov, aka Space Weather Woman, provides weekly space weather forecasts and one-off videos when large storms are forecast
- ▶ **spaceweather.com** is a fantastic resource for checking auroral activity levels and 48-hour geomagnetic storm predictions
- ▶ **aurora-alerts.uk** This is where to download Glendale, which claims to be the most accurate aurora forecasting and alerting app in the world

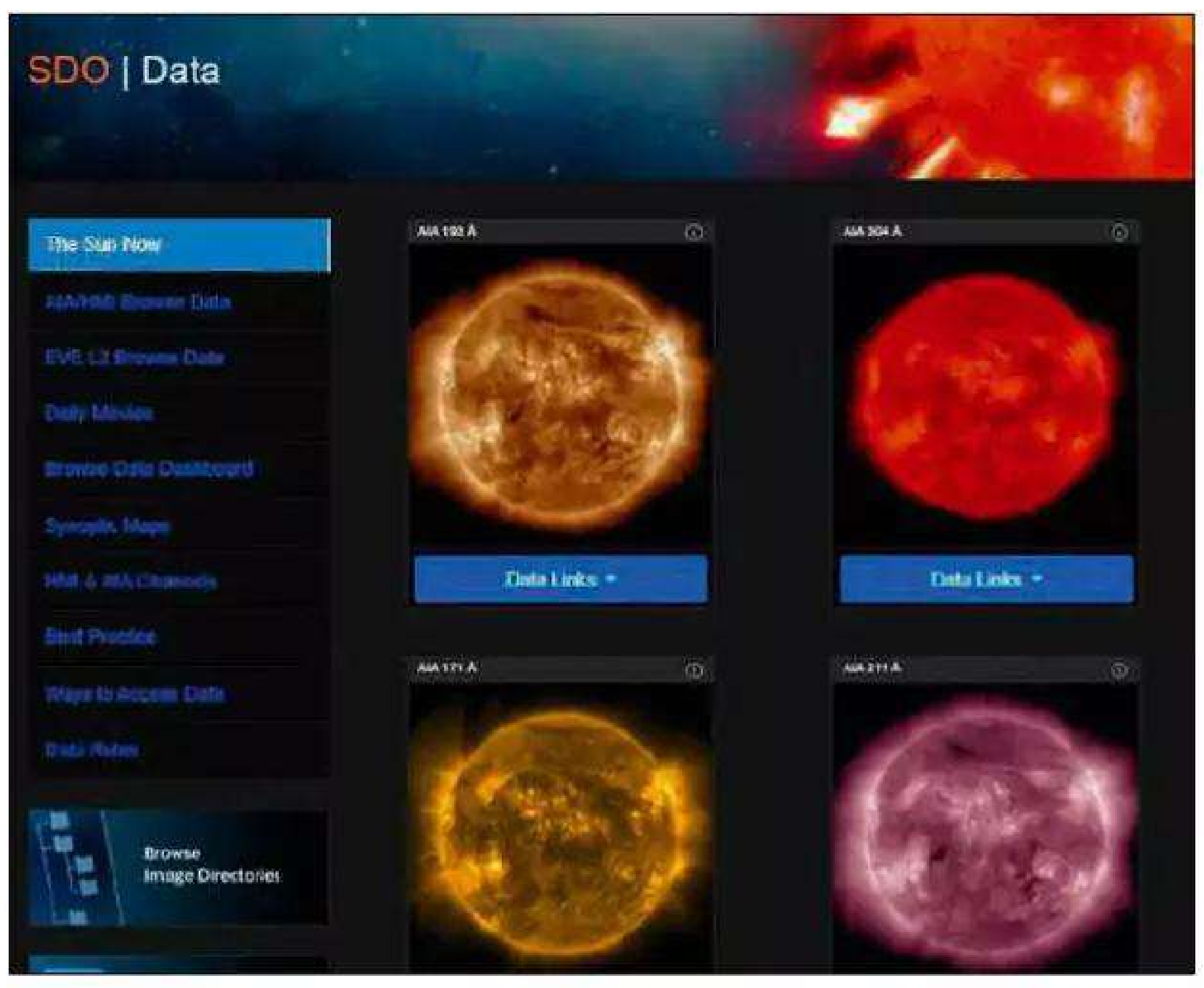
We have satellites imaging the Sun in different wavelengths and recording solar flares and CMEs. Real-time magnetic data and geomagnetic storm predictions are published on websites, social media and apps. All this information will help you to predict if there's a chance of aurorae where you are. However, the only thing you can accurately predict about aurora displays is their unpredictability!

Some websites rate the activity level using the Kp Index, with a scale of 1 to 9. The higher the number, the further south (or north) aurora can be seen. Others publish the interplanetary magnetic field data. The total value (Bt) is measured in nanoteslas, but also crucial is its polarity (Bz). If the Bz is negative (the greater the negative value the better), it shows more charged particles are pouring into our magnetosphere, causing a stronger aurora in the coming hours.

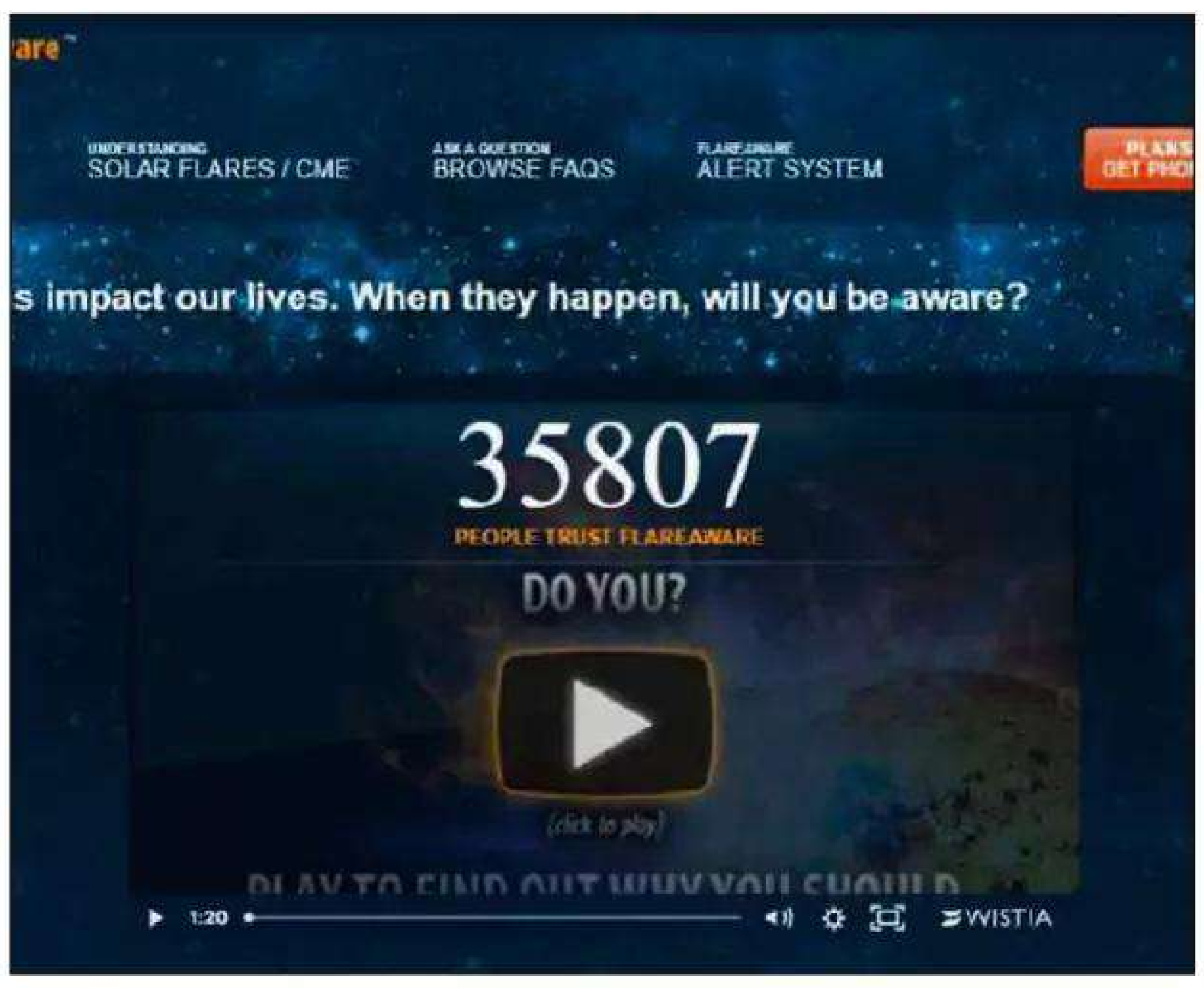
To see the aurora, you need a clear view of the northern horizon (or southern horizon if you're in the Southern Hemisphere) and to allow your eyes to dark-adapt. Aurora displays are not as colourful as they are in photos, so be realistic about what you'll see. If you are at a mid-latitude location, bursts of active aurorae may be short-lived, so be ready to act fast!

Mary McIntyre is an outreach astronomer and teacher of astrophotography

6 ways to predict the aurora


SDO | Data
The Sun Now
Data Links
Data Links

1 Visit the Solar Dynamics Observatory website and look at the daily 211 angstroms photo. Any dark regions are coronal holes. If these dark areas are in the Sun's equatorial region, faster solar wind will be Earth-directed and may result in geomagnetic storms a couple of days later.


SOLAR FLARES / CME
BROWSE FAQS
ALERT SYSTEM
s impact our lives. When they happen, will you be aware?
35807
PEOPLE TRUST FLAREAWARE
DO YOU?
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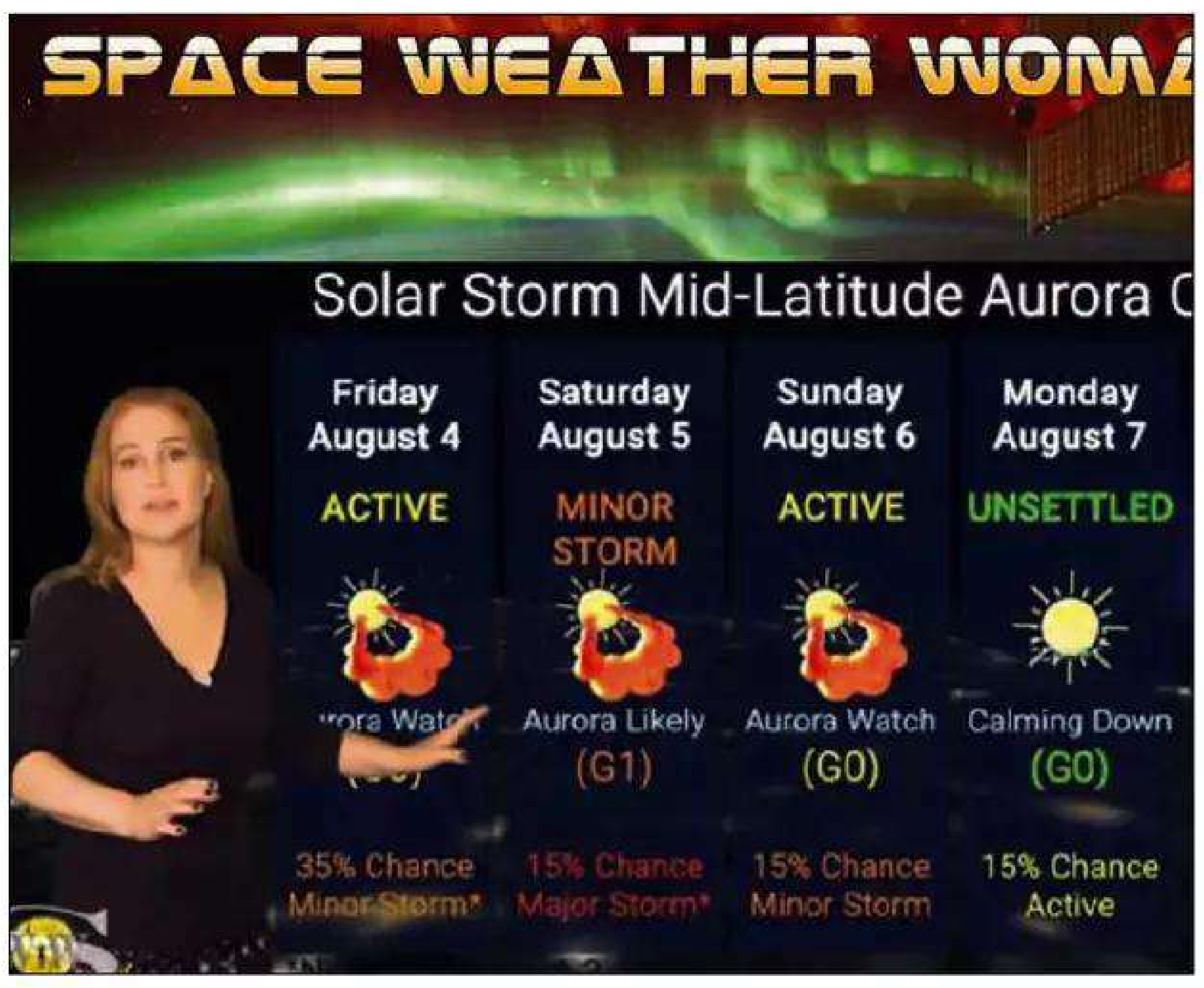
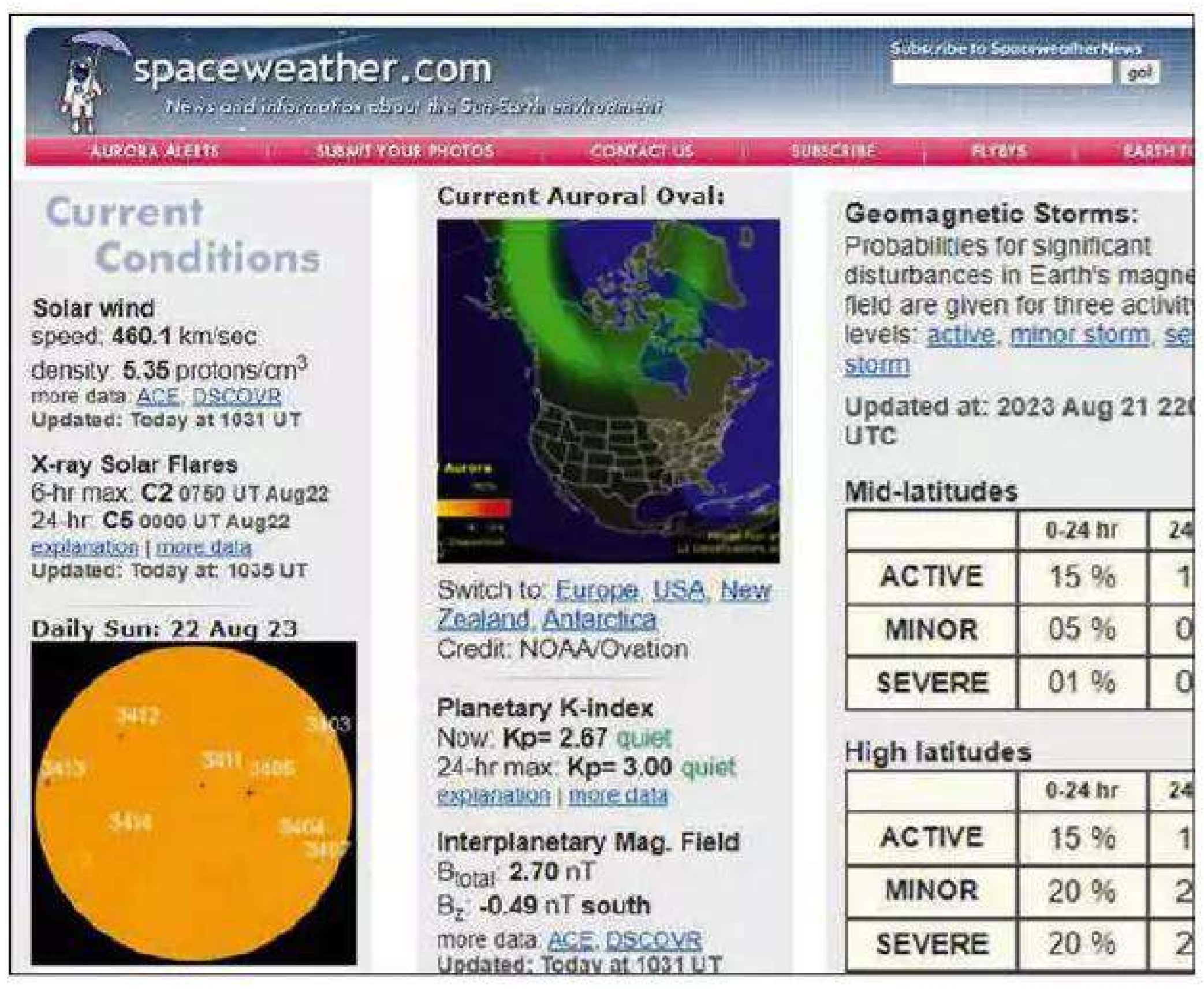
2 Check the Flare Aware website to see how many solar flares have taken place recently and if there are any Earth-directed CMEs associated with them. Even CMEs that aren't directly heading for Earth can give us a grazing blow and bump up auroral activity.


SPACE WEATHER WOMA
Solar Storm Mid-Latitude Aurora C
Friday August 4
Saturday August 5
Sunday August 6
Monday August 7
ACTIVE
MINOR STORM
ACTIVE
UNSETTLED
Aurora Likely (G1)
Aurora Watch (G0)
Calming Down (G0)
35% Chance Minor Storm*
15% Chance Major Storm*
15% Chance Minor Storm
15% Chance Active

3 Subscribe to Tamitha Skov's YouTube channel and watch her space weather forecast videos. She analyses the NOAA and NASA prediction models following significant CMEs, and gives geomagnetic storm probabilities for high-latitude and mid-latitude regions.


spaceweather.com
AURORA ALERTS
SUBMIT YOUR PHOTOS
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FLYBYS
Current Conditions
Current Auroral Oval:
Geomagnetic Storms:

Solar wind
speed: 460.1 km/sec
density: 5.35 protons/cm³
Updated: Today at 1031 UT

X-ray Solar Flares
6-hr max: C2 0750 UT Aug22
24-hr: C5 0000 UT Aug22
Updated: Today at 1035 UT

Daily Sun: 22 Aug 23

Switch to: Europe, USA, New Zealand, Antarctica
Credit: NOAA/Ovation

Planetary K-index
Now: Kp= 2.67 quiet
24-hr max: Kp= 3.00 quiet

Interplanetary Mag. Field
B_{total}: 2.70 nT
B_z: -0.49 nT south
Updated: Today at 1031 UT

Probabilities for significant disturbances in Earth's magne field are given for three activit levels: active, minor storm, se storm

Updated at: 2023 Aug 21 22 UTC

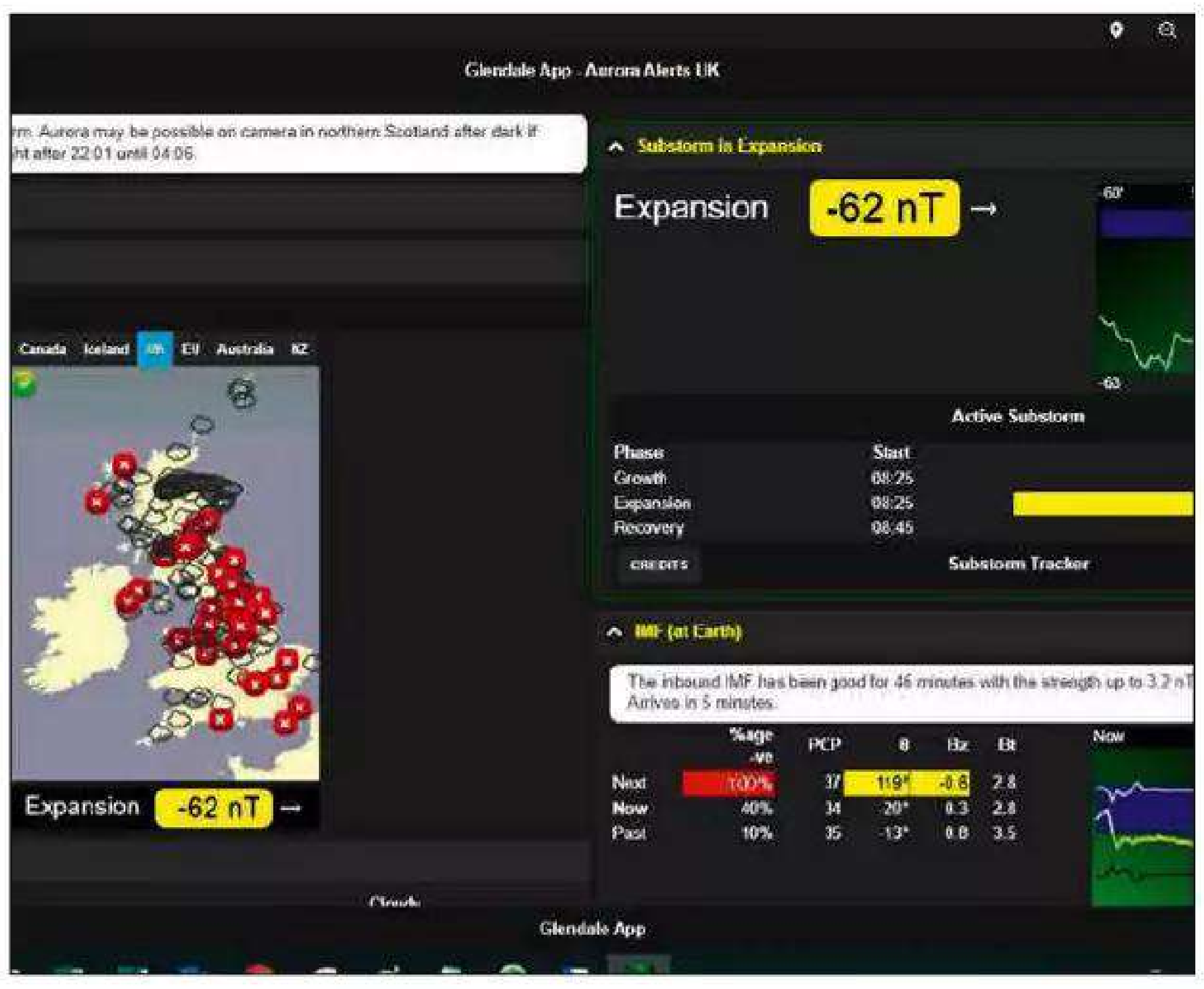
Mid-latitudes

	0-24 hr
ACTIVE	15 %
MINOR	05 %
SEVERE	01 %

High latitudes

	0-24 hr
ACTIVE	15 %
MINOR	20 %
SEVERE	20 %

4 Spaceweather.com summarises recent solar flares, coronal holes, current solar wind speed, Kp (geomagnetic activity), Bt (interplanetary magnetic field) and Bz (polarity) levels, current position of the auroral oval and probability of geomagnetic storms from high and mid latitudes in the next 48 hours.


Glendale App · Aurora Alerts UK
Substorm in Expansion
Expansion
-62 nT
Active Substorm
Substorm Tracker
Expansion
-62 nT
Glendale App

5 Input your location into the Glendale Aurora Alerts App and it will provide geomagnetic measurements specific to your area rather than the global readings. It gives live, real-time alerts, and other app users add green ticks on a map if they have aurorae, so you can see at a glance if you're in with a chance yourself.

Live Stream Highlights
Live from Lapland
Aurora Borealis LIVE!
Sponsored by Aur

6 There are many aurora webcams around the world, including in Norway, Canada, Finland and the Shetlands in the UK. Studying the view from live cameras in your country allows you to monitor how active an aurora display is in real time and can help you predict whether the aurora will reach your location.

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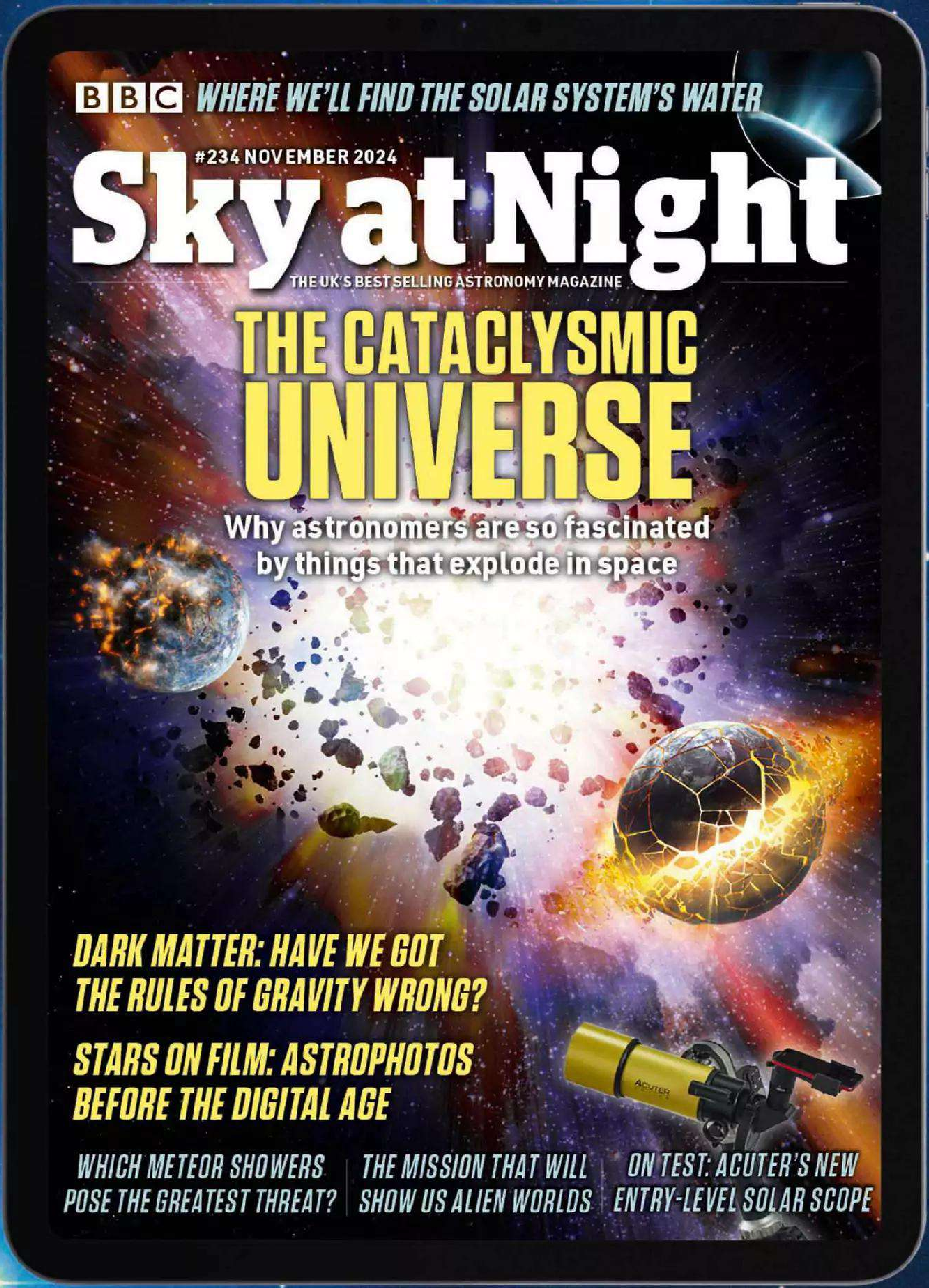
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STARS ON FILM: ASTROPHOTOS BEFORE THE DIGITAL AGE
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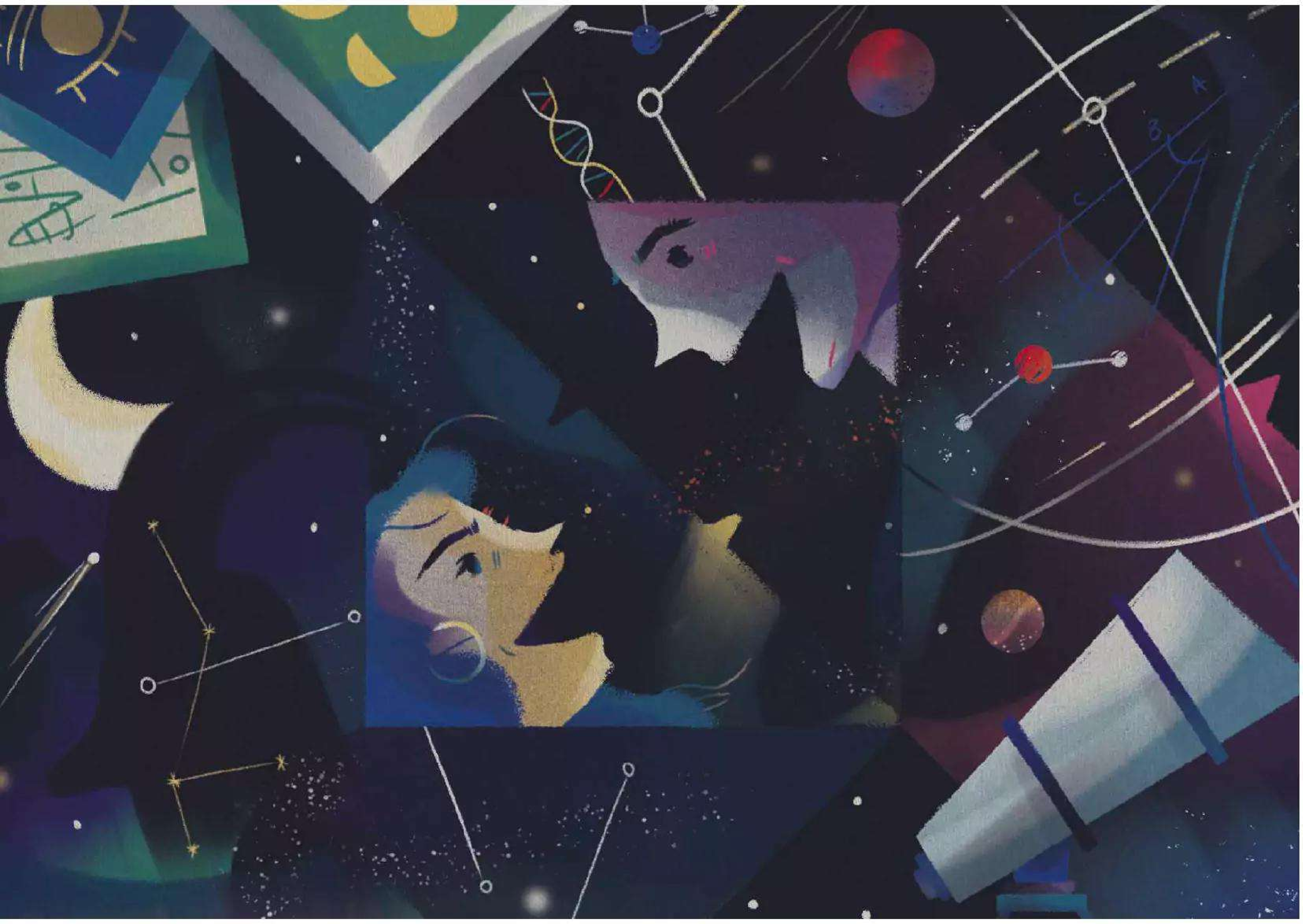
News

A closing thought...



JIA-YI LIU/FOLIO ART

Never the twain shall meet?

While astronomy and astrology are clearly poles apart, **Jonathan Powell** discovers a shared passion for the stars

Ask me to talk about astronomy to anyone showing an interest, and I immediately download the classic Patrick Moore delivery technique, high-speed, detailed and wonderfully passionate.

My interest in astronomy began at such a young age that no one else was into it, they all preferred football and cricket. And while I followed these sports and still do, I've developed the habit of talking to anyone showing even the slightest interest in the stars as if I was a missionary, enlightening those with time to listen about the stars and planets, and attempting to match my output with anything currently on view in the night sky. A chance to show rather than just talk about astronomy.

Therefore, when a friend of mine said that a newly found mutual friend didn't realise I had such a passion for the stars, I was understandably keen to impart all I could; not to impress, but to show that astronomy is very accessible.

When I've talked to others about the subject over the years, it's been a surprise exactly how many people, of all ages, have an interest in astronomy, but have never taken it beyond the point of it just being a casual affair. Their enthusiasm intermittently rekindles upon the arrival of a bright comet in our skies, a supermoon perhaps, or just sighting Venus in the morning or evening sky. One only has to look at the interest shown UK-wide during the last return of Halley's Comet to see how people react to something they can see, rather than just be told about it. It makes a world of difference.

As soon as possible, my newly discovered friend and I met up and, bubbling with excitement, I reeled off a summary of my involvement in astronomy since prehistoric times. As I delivered my keenly expressed words, her eyes lit up and were accompanied by a broad smile – it appeared as if common ground had been reached. Indeed, I thought 'first contact' had been established.

When I had finished delivering my verbal barrage, she replied positively but with a dialogue that included words such as 'zodiac' and 'spiritual'. I realised quickly I had followed the right rabbit but down the wrong hole, as it was astrology she was interested in, not astronomy. Having quickly returned up and out of the hole I'd gone down, the conversation from that point remained pleasant and civilised, but at cross-purposes.

The stars to some mean something completely different to the science of astronomy. However, one must respect the chosen passion, pursuit, and interest that others have, as to them it is held in the same regard as that which we astronomers invest in our own field.

History tells us that for many ancient civilisations, the two subjects of astrology and astronomy were once very much intertwined, with a great deal of time, care, and attention taken to recording events in the night sky. Coupled with a belief system, this early approach resonated throughout many cultures across the globe.

Sir Patrick, however, had a much more succinct, one-word definition of astrology: "Bunkum!"

Jonathan Powell is the astronomy correspondent for the *South Wales Argus*

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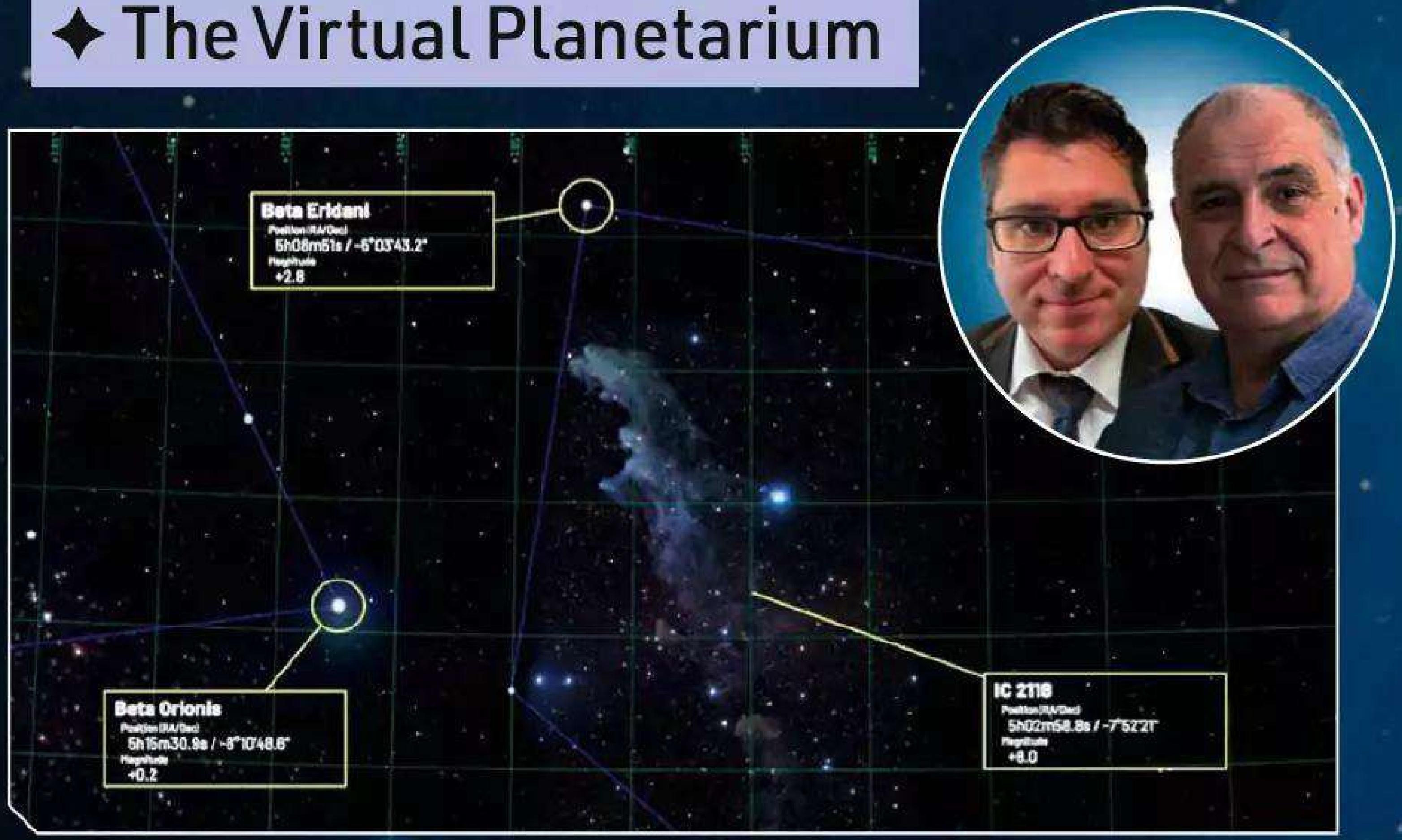
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